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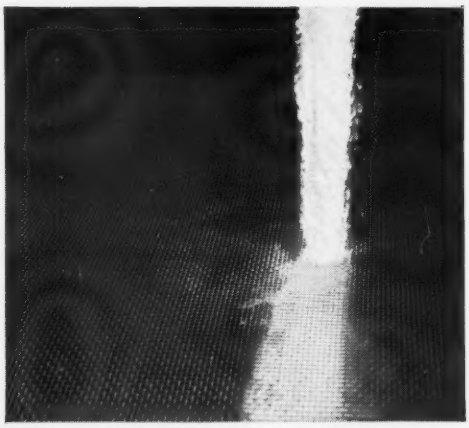

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The American Association of Cereal Chemists is devoted to: 1) the encouragement of scientific and technical research on cereal grains and their products; 2) the study of development and standardization of analytical methods used in cereal chemistry; 3) the promotion of the spirit of scientific cooperation among all workers in the field of cereal chemistry; 4) the maintenance of high professional standards of its membership; and 5) the encouragement of a general recognition of the value of the chemist and biologist to the cereal industries.

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# CEREAL SCIENCE today

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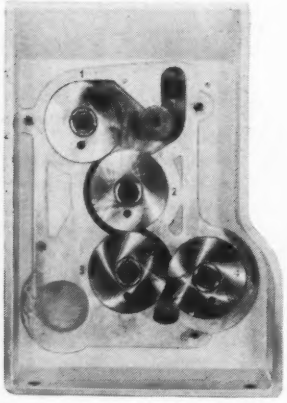

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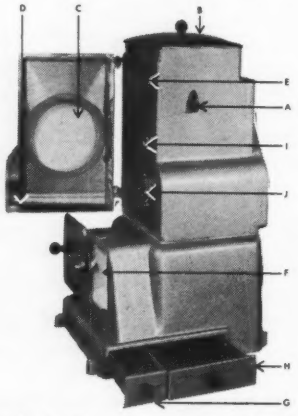


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# Editorial

At the recent AACC meeting, we heard a reference to people who were described as "knowing so much more than they understand." The significance of that phrase has grown as we have reflected upon it. It is susceptible to different interpretations, and we are not going to presume to know exactly what the speaker had in mind. In various contexts, the characterization might be applied to many individuals or groups.

More research is being conducted today than in any period of our history and technological development is progressing even faster. With most of these activities conducted by teams of workers, it is far easier for the individual to add to "knowledge" than to add "understanding." Indeed, many might believe this is enough — "If it works, what more is needed?" We challenge that viewpoint. Human civilization has been advanced largely by man's insatiable curiosity, a desire to know not only "who" and "what", but also "how" and "why."

The educational process is far more efficient when the student *understands* than when he learns by rote. Research today is too costly and too competitive to be done by investigators who do not understand the established principles of experimental design.

We don't know how the measurements could be made, but assuming it were possible, it would be most interesting to see a tabulation of the ratios of "knowledge" to "understanding" in different fields of science and technology and in the same fields throughout their chronological development.

It is difficult to judge current research publications, just as it is difficult to objectively appraise contemporary literature or music. But look back through the older scientific publications in our own field. We think you'll agree the "classics", those just as worthwhile to read today as when they were published, are the papers that were milestones along the road to "understanding."

Paul E. Ramstad

A FREE-WHEELING ANALYSIS OF

# Flour Research Problems[1]

By R. Gracza, The Pillsbury Company, Minneapolis, Minnesota

FLOUR USERS USUALLY define the utility of a flour with the term "desired performance" in their product or process. They are customers, and in our society the customer is always right; so the problem of providing the specific flour remains to the supplier, who has the task of developing tests meaningful to himself, which can guide his production. A large number of our flour indices in use at present do not serve the final consumers but rather the production problems of the middleman, especially the commercial baker. Some testing methods of the past are becoming obsolete; others need review for interpretation or validity limits, or adjustment for better accuracy. There is also a need for development and adaptation of new methods which can be used to control and/or explain the effects of new technical developments.

### The Challenges Faced by Cereal Chemists

Occasionally cereal chemists are asked to develop a foolproof, magic number which, if applied, can prevent the consumer from going wrong in his production. The answer to this challenge is easy. There are no foolproof, magic numbers. However, legitimate challenges for guidance or interpretation of indices which are addressed to AACC members by the representatives of the industry are to be taken seriously.

Atherton Bean of the International Milling Company formulated well the character and direction of the information in which the industry is interested and for which it probably is willing to pay. He said in October 1957, in Peoria, "More fundamental knowledge of the molecular structures and the physical and chemical properties of flour mill products and their significance relative to baking characteristics is needed. The possibilities that such findings would open the way for improvement in baking, in the production of new foods, or in industrial utilization could then be explored. A new system for testing wheat flour quality might be necessary." This outline is very general. John Snyder of The Pillsbury Company at our 1958 Cincinnati meeting solicited answers to such problems as:

"The inability to write quantitative specifications for flour based on objective tests instead of test baking;

"Reliable explanation and/or indices to by-pass trial-by-error methods or dilution techniques in the mill at yearly crop changeover;

"Explanation and/or control variability in crust and crumb characteristics, cookie - feathering, dough buckiness, undesirable symmetry characteristics, and absorption variations;

"Meaningful index for baking performance without the traditional dependence on protein and ash content; and

"Isolation and identification of the so-called quality factors in wheat and/or flour."

He further raised these questions: "How about starches in the flour after spending much effort with proteins? How about molecular bonds, enzymes, fats in flour?"

R. H. Cotton of the Continental Baking Company at the 1959 Washington meeting asked, in essence, why two flours with the same protein, moisture, and farinograph data bake differently.

These are examples of the type of problems our industries face and of the kind used in the challenges to the industry. Before solving these problems and in order to define them, these popular, rather subjective connotations of buckiness, feathering, and so on must be translated into the unequivocal, measurable, scientific language. Inaccurate formulation of a practical question may easily direct a research project to "swampy" areas without exits.

After the problem is expressed in independently measurable variables, a literature survey is made to find figures and conclusions relating to the problem; however, because of the emphasis needed or variables to be considered, it is seldom that direct answers are found. Attention is called to the trap of communication by indices, words, and conclusions. The absolute numerical value of an index or the arbitrary meaning of a word or an arbitrary interpretation of experimental figures is never important, but the *phenomena or conditions they describe* are important. Words like *protein content, absorption,* and *denaturation,* or their numerical value, are often used in explanation of certain phenomena. These terms are perpetuated to provide some form of communication or for convenience, but it may paralyze progress in research, where not only the experimental results are to be recorded but also the "why?" of the experimentally measured changes should be explained. In research, explanations must be made with logical coherence; each experimental observation needs an explanation.

These are, in a nutshell, the gen-

[1] Based on a talk given at the 45th annual meeting, Chicago, May 3, 1960.

eral problems of the industry and the challenge they present to research. A free-wheeling analysis (without prejudgment) of some flour problems follows.

### A Close Look at Flour

The individual steps in the procedure of handling cereal grains from harvesting to final consumption are in the hands of increasingly larger numbers of separate technical groups. Each of these groups has its own special limited area of responsibility and interest. Obviously, each group specifies requirements by its own terminology believed to be important to the group. Wheat growers, flour millers, salesmen, bakers, and probably nutritionists each have a different list of specifications. For example, Kent-Jones and Amos (12) give the following seven indices for the approximate composition of 72%-extraction white flour:

| | % |
|---|---|
| Moisture | 13.0–15.5 |
| Starch | 65 –70 |
| Protein (N × 5.7) | 8 –13 |
| Cellulose (fiber) | Trace to 0.2 |
| Fat | 0.8– 1.5 |
| Sugar | 1.5– 2.0 |
| Mineral matter (ash) | 0.3– 0.6 |

However, Watt and Merrill (21) give a much longer list for a patent all-purpose, unenriched family flour:

| | |
|---|---|
| Water | 12% |
| Food energy | 364 cal/100 g. |
| Protein | 10.5% by weight |
| Fat | 1.0% by weight |
| Carbohydrate: | |
| Total | 76.1% by weight |
| Fiber | 0.3% by weight |
| Ash | 0.43% |
| Calcium | 16 mg/100 g |
| Phosphorus | 87 mg/100 g |
| Iron | 0.8 mg/100 g |
| Vitamin A | I.U. (°) imputed value |
| Thiamine | 0.06% |
| Riboflavin | 0.05% |
| Niacin | 0.9% |
| Ascorbic acid | (0) |

These two lists are typical in handbooks identifying flour by its chemical components. The authors use or do not use an index according to its importance in their own fields of interest.

While the Definitions and Standards of Identity (7) for flour may not describe or characterize flour behavior for *all* practical applications, it serves the public and industry by defining limits in procedural, physical, and chemical terms.

It is interesting that none of these references list in high priority an index which refers to the *hydration property* of flour. However, since practically all of our cereal products will be exposed to water in one way or another before final consumption, the importance of hydration indices becomes obvious. These hydration indices would be concerned with: 1), the hydration rate in limited and unlimited amounts of water; 2), the dehydration rate, as in baking; 3), the water absorption capacity; 4), the water retaining capacity; and probably with many other phenomena associated with the amount of water and within the wide temperature range in which flours are used.

### A Close Look at Hydration

Microscopic observations of a flour in water or aqueous stain solutions show that different flour particles imbibe water at *a different rate.* With the addition of water and slight kneading between slide plates at room temperature level, the gumlike protein matrix of the flour particles assumes a plastic-elastic consistency. The character of this consistency appears to be dependent on the concentration and distribution of water molecules across the former unwetted protein matrix which, in this wetted condition, is called gluten. Its consistency is often referred to as being between sol and gel. The energy applied by kneading or dispensed from molecular storage distributes the water homogeneously within the gluten mass or gluten film.

The starch granules, the major portion of the flour, appear to ad/absorb little, if any, water at room temperature whether they are or are not covered with gluten matrix, unless the granules are seriously cleaved. Broken or cracked granules imbibe water instantaneously and a mudlike, hydrated starch matter which swells is created.

After a time, in the gelatinization temperature range, the granule surface ad/absorbs water if it is available; above that temperature, the granules produce the mudlike substance which has no organized structure since its characteristic birefringence is lost. At boiling temperature in excess water, the natural architecture of the granules disappears.

These well-known and direct observations suggest many simple statements as a point of departure for questions which, if answered or partly answered, could reveal the part gluten and starch granules play in flour hydration; statements such as:

1) The consistency of gluten (between sol and gel) is dependent on the gluten-water concentration.
2) By necessity, the water starts imbibition through free particle surface as a result of some energy.
3) The natural starch granule surface is practically resistant to water penetration at room temperature.
4) In the gelatinization temperature range and/or above, the resistance of starch granule surface against water penetration practically ceases.
5) Cleaved starch granule surfaces imbibe water spontaneously at room temperature and above.

Now some questions are suggested: Is the elasticity of gluten, as seen on the microscope slide and occurring in the dough, dependent on factors different from the water content, such as: 1) the average molecular length or the quantitative distribution of molecules with different length? 2) the molecular attraction or any other structural binding at the interfaces of starch granules and gluten film? 3) degree of molecular orientation?

The second question refers to the hydration of starch granules. What controls water penetration through the starch granule surface — 1) the molecular arrangement of starch and/or protein compounds at the interface of starch granules and protein film? 2) chemically identifiable compounds other than starch and protein? 3) a chemical compound in any way related to the decomposition of starch granule structure starting at the gelatinization temperature?

### Consider the Starch

The question of damaged, or rather, split starch granules (ghosts) is a fashionable one and is widely discussed in the literature, especially in connection with diastatic activity. Kent-Jones and Amos (12) review the literature and explain up-to-date concepts on diastatic activity involving the "ghosts." About flour hydration, however, which is a basic practical phenomenon of flour without which no gas production could occur, very little is said in this book.

Microscopic observations indicated different water absorption and penetration rates into the starch granule at its natural surface when compared to water absorption and penetration rates at the surface exposed by a cracked granule. An obvious question is: "Will or will not more water be ad/absorbed at constant consistency in a flour-water mixture through cracked granule surface as compared to intact surface?"

To obtain some answer to this simple question, a simple test was run in which water-washed and dry-processed starches were ball-milled for 42 hours (to crack them open) and mixed in increased proportion with a hard winter wheat flour. These were compared, using some hydration indices, with similar mixtures where the starches were not ball-milled. Figures 1 and 2 compare the starches.

The increase of free starch granule surface in a hard wheat flour reduces its farinograph absorption at about constant consistency; an increase of cracked granule surface in the same flour rapidly increases the farinograph absorption of the mixture at about constant consistency. A similar pattern is evident in the alkaline water retention capacity values. The figures are affected, of course, by the increased specific surface and probably by many other variables that increase or decrease absorption. Table I shows the absorption decreases in both starch systems in the control series with increased specific surface as the decreasing average particle size (Fisher) illustrates. However, in the ball-milled series, the absorption increases with increased specific surface (lower Fisher).

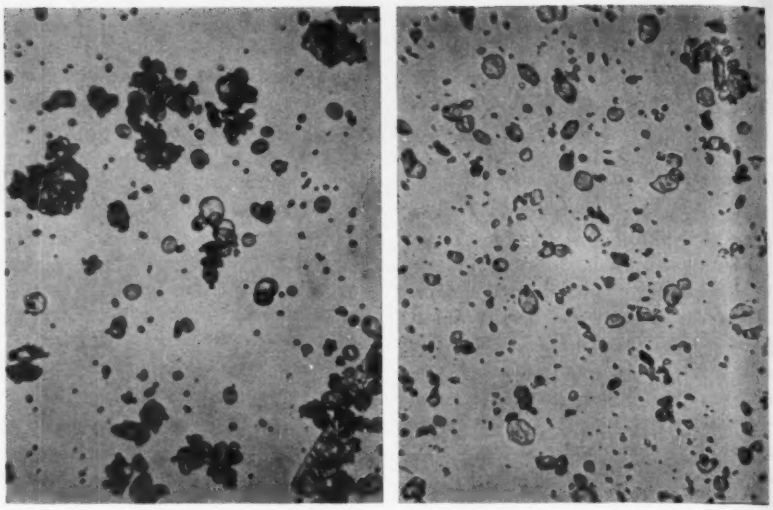

Fig. 1. Photomicrographs comparing (left) commercial wheat starch (water-washed) and (right) its 42-hour ball-milled counterpart. Slides were prepared in oil of 1.600 refraction index. Power of magnification 180×.

If the measured absorption changes are the effect of the amount and kind of specific surfaces, it must be resolved in what degree the amount and in what degree the kind is responsible for those changes.

Assuming direct linear relation between absorption and specific surface, it can be calculated that the absorption increase caused by ball-milling is due in larger degree to the kind of surface than to the amount of surface; namely, the $104.4 - 54.1 = 50.3\%$ and $87.2 - 50.3 = 36.9\%$ increase in total farinograph absorption is shared by the kind and increased amount of surface variables in 1.1 and 6.0 proportion, respectively, in the water-washed and air-classified wheat starches. In short, this would mean that the open cracked internal starch granule surface of the dry processed starch possesses a hydration capacity about six times that of the external starch granule surface.

With the hydration behavior of different starch surfaces established by data not directly related to microscopics, another question arises: If the entire starch granule is homogeneous, why do newly generated internal surfaces have a hydration capacity amplified over that of its natural surface?

If the chemical components of flour are reviewed, it is found that fat is the only one which has the property of resisting water. The percentage occurrence of fat in flour is small, about 1% as compared to the 65–70% of starch, which suggests that fat is a controlling agent rather than a contributory component of the flour, especially in the starch hydration phenomenon. This small amount of fat, if homogeneously distributed within the structure of the starch granule, cannot be directly responsible for the rather dramatic hydration changes; however, if it is strategically located, for instance *in the vicinity of the starch granule surface*, it may be very important in controlling water penetration into the starch granules.

An electron-microscope study conducted by our laboratory showed a darker shadow ribbon in the broken section along the surface of an exploded starch granule measuring

Fig. 2. Photomicrographs comparing (left) low-protein fraction of a soft wheat flour (dry-processed wheat starch) and (right) its 42-hour ball-milled counterpart. Slides were prepared in oil of 1.600 refraction index. Power of magnification 180×.

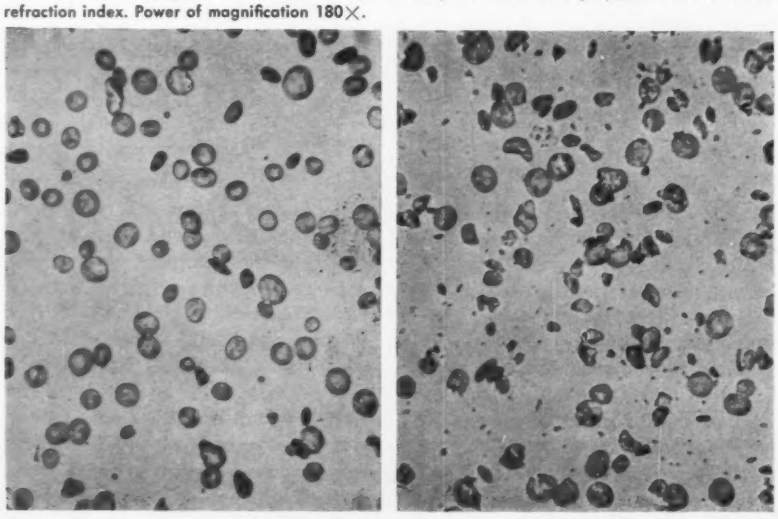

Table I. Effect of Unground and Ball-Milled Starches on the Hydration Properties of Hard Winter Wheat Flour

| *Starch* | | *Hard Wheat Flour* | *Moisture* | *Farinograph Absorption* | *Alkaline Water Retention Capacity* | *Fisher* | *Maltose* | |
|---|---|---|---|---|---|---|---|---|
| | % | % | % | % | % | % | % | |
| Water-washed | 100 | 0 | 8.5 | 54.1 | 64.6 | 14.5 | 23 | |
| wheat starch | 60 | 40 | 10.0 | 55.0 | 59.1 | 16.0 | 186 | |
| control series | 30 | 70 | 11.0 | 56.4 | 58.2 | 17.8 | 119 | The absorption increase 104.4 − 54.1 = 50.3% in total farinograph absorption is shared between the kind and increased amount of surface variables in 26.4/23.9 = 1.1 proportion. |
| starch | 0 | 100 | 11.2 | 60.6 | 67.5 | 19.2 | 189 | |
| Ball-milled | 100 | 0 | 9.2 | 104.4 | 247.7 | 10.0 | 44 | |
| (42 hours) | 60 | 40 | 9.6 | 87.8 | 179.4 | 11.7 | 571+ | |
| water-washed | 30 | 70 | 10.5 | 73.6 | 112.2 | 14.3 | 577+ | |
| wheat starch | 0 | 100 | 11.2 | 60.6 | 67.5 | 19.2 | 189 | |
| Air-classified | 100 | 0 | 6.0 | 50.3 | 61.2 | 13.9 | 84 | |
| wheat starch | 60 | 40 | 8.1 | .... | .... | 15.4 | 107 | |
| control series | 30 | 70 | 9.6 | 54.4 | .... | 18.0 | 141 | The absorption increase 87.2 − 50.3 = 36.9% in total farinograph absorption is shared between the kind and increased amount of surface variables in 31.6/5.3 ≅ 6 proportion. |
| starch | 0 | 100 | 11.2 | 60.6 | 67.5 | 19.2 | 189 | |
| Ball-milled | 100 | 0 | 6.5 | 87.2 | 33.1 | 12.6 | 201 | |
| (42 hours) | 60 | 40 | 8.5 | 71.3 | 45.3 | 14.0 | 568 | |
| air-classified | 30 | 70 | 9.7 | 67.4 | 82.1 | 16.2 | 422 | |
| wheat starch | 0 | 100 | 11.2 | 60.6 | 67.5 | 19.2 | 189 | |

about 80 Angstrom (A) thickness. In confirmation of this measurement and working independently, Hess[2] presented an electron-microscope picture of a section of truncated starch granule showing a darker edge 100 A thick at the periphery of the elliptical cross section. This darker peripheral portion appeared to have the same structure as the other areas of the cut starch surface except it was darker[3].

If the mosaic of the discussed direct observations[4] is assembled, it can be suspected that the factors controlling water penetration in the vicinity of the starch granule surface are the lipids, specifically, lipoids and fats.

This statement is not in line with the general belief that more flour lipids can be observed where more protein is available. This means that in the starch there is no fat, or only a negligible amount. While it is known that part of the fat molecules of wheat are more or less dispersed among other molecules as in the wheat endosperm, other fat molecules occur in congregations of globules or layers in the aleurone and germ portions of the wheat. In flour hydration, of course, the individually distributed fat molecules are being considered.

There are indications that the petroleum ether-extractable endosperm fat is not homogeneously distributed within the protein matrix but is somewhat concentrated in the vicinity of the starch granule surface. For instance, in a soft wheat flour, it was found that 15.27% of the fat was associated with the unit protein. In its high-protein fraction, consisting of small starch granules and protein matter fragments, only 10.3% of the fat was associated with the unit protein. The low-protein fraction, consisting of larger starch granules with occasional protein layers adhering to them, had 20.3% of the fat associated with the unit protein. These figures indicate the concentration of fats in the portion of protein associated with the (major) starch granules. To illustrate this concept of lipid to protein ratio, let it be assumed that lipids are homogeneously distributed within the microscopically observable protein matrix; then the matrix unit (volume) of air-classified high-protein and low-protein fractions (as determined by the Kjeldahl method and N × 5.7 factor) carries about 10.3 and 23.3% of the petroleum ether-extractable lipids available in the respective fractions.

Table II. The Limited Amount of Lipids in Starches Obtained by Extraction and/or Hydrolysis

| | *Petroleum Ether Extraction* | *Fat by Acid Hydrolysis* |
|---|---|---|
| | % | % |
| Corn starch, purified ether-extracted (13) | ... | 0.6 |
| Corn starch | 0.01 | 0.91 |
| Wheat starch | 0.01 | 1.05 |
| Low-protein fraction of Michigan soft white wheat | ... | 2.05 |
| Low-protein fraction of Ohio soft red winter wheat | 0.18 | 2.62 |

It can be shown by mathematical calculations that, in an imaginary flour consisting of starch granules with a major axis of 25 micron and minor axis of 12.5 micron, a 100-A surface layer of the granules represents about 0.3% of the total volume. This 0.3%, neglecting density differences, is a close approximation of the amount of fats occurring in starches and indicates that the extremely small amount of fats may not be neglible; i.e., by their potential strategic location they could control the water penetration into the starch granules.

In flours or flour fractions untouched by water, small starch granules are concentrated where the protein matter is concentrated. These small granules may carry more lipids because of their higher specific surface, i.e., where their 80 or 100-A layer is relatively greater than where larger starch granules are concentrated and, hence, protein content is depleted. This means that the general observation that fats go with protein is not contradicted by the proposed explanation; however, it implies that protein relation to fat content may be only incidental.

### Lipids and Their Effect on Starch

Turboclassified low-protein fractions provide a good source of unwetted starches of rather narrow size

[2] Private communication (1955).
[3] Hess (10) claims that he removed the darker layer by proteolysis.
[4] Natural starch surface does not hydrate, whereas free surface of internal portion of starch granules absorbs water spontaneously. There is a shadow ribbon 80 to 100A broad along the edge of the cross-section of a starch granule. Naturally available fats (lipids) are preponderantly hydrophobic; however, their derivatives and some components are different in character.

range. The destruction, disruption, or modification of the aforementioned 100-A peripheral portion of starch granules and the use of chemical-physical indices may lead to new observations, to new knowledge.

Three turboclassified low-protein products were ball-milled for 1, 6, and 24 hours. The purpose of this treatment was to provide new routes for petroleum ether extraction of lipids below the outer surface of the starch granules. The starch granules were crushed in the ball mill in such a manner that under the microscope they looked like cracked nuts; the broken or newly formed portions generally still formed a coherent granule with only a few portions of the granule falling apart. The greater increased specific surface suggests that more or at least the same amount of fats could be extracted from the ball-milled samples. However, the data of Table III show that the petroleum ether-extractable fats dwindled to 10% of the original content with increasing grinding time, and at the same time, the free fatty acid portion of the remaining fats slightly increased.

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| | *Ball-Milled* | *Fat by Petroleum Ether Extraction* | *Free Fatty Acid on Fat Basis* | *Fat by Acid Hydrolysis* | *pH* | *Maltose per 10 g. Stock* | *Alkaline Water Retention Capacity* |
|---|---|---|---|---|---|---|---|
| | *hours* | % | % | % | | *mg* | % |
| Low-protein | Control | 0.137 | 15.3 | 1.52 | 5.50 | 146 | 72.2 |
| fraction of | 1 | 0.110 | 12.4 | ... | 5.50 | 163 | 76.4 |
| Lemhi wheat | 6 | 0.091 | 21.9 | ... | 5.45 | 266 | 95.9 |
| flour | 24 | 0.013 | 20.5 | 1.18 | 5.45 | 386 | 199.6 |
| Low-protein | Control | .... | ... | 2.05 | .... | 80 | 72.3 |
| fraction of | 1 | 0.100 | 23.0 | ... | 5.35 | 91 | 76.1 |
| soft white | 6 | 0.054 | 38.4 | ... | 5.30 | 171 | 93.3 |
| wheat flour | 24 | 0.036 | 61.0 | 0.90 | 5.25 | 158 | 225.2 |
| Low-protein | Control | 0.180 | 26.5 | 2.62 | 5.85 | 89 | 58.2 |
| fraction of | 1 | 0.147 | 31.8 | ... | 5.80 | 125 | 65.8 |
| soft red winter | 6 | 0.120 | 36.7 | ... | 5.75 | 325 | 89.8 |
| wheat flour | 24 | 0.064 | 45.0 | 1.30 | 5.45 | 512 | 184.8 |

With these observations, the explanations of what may have happened to the lipids in the ball mill follow:

1. Perhaps the porous balls and walls of the ball mill adsorbed some lipids from the granule surface; in the crushing procedure heat is produced, and this could liberate some local lipid molecules.

2. Perhaps the local heat evaporated portions of lipid molecules which were loosely bound in the molecular fabric of the starch granule surface.

3. Perhaps the concentrated physical stress in crushing broke molecular linkages of the large lipid molecules whose products partially evaporated.

4. Perhaps the presence of air in the crushing procedure transformed natural triglyceride to a form which cannot be extracted by petroleum ether.

5. Perhaps two or more of the possibilities occurred. If so, a question of importance, order, and sequence remains to be answered.

6. It may be possible that the modified natural triglyceride or its transformation product in the granules reacts with the new form of the starch granule and is unextractable.

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Realizing the important change in the behavior of fats which may be brought upon them by their chemical and physical modifications, in our laboratory we ran tests on flours to characterize certain physical changes with the help of lipid, especially fat, indices.

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the amount of applied chlorine gas and iodine value, suggesting strongly that the double bonds of the unsaturated fatty acids are occupied by the chlorine through an addition reaction. If it is considered that the decrease in free fatty acid content with lower pH is very near within analytical error, it may be concluded that the registered physical changes may have been brought on by the saturation of fatty acids within the architecture of starch granules. Of course, it is also quite possible that the primary cause of increased hydration capacity is the partial disentanglement of the molecules within the peripheral portion of the starch granules, and that the recorded fat indices (except free fatty acid) are incidental to this change, as apparently the pH is incidental too. However, both indices are available by laboratory methods as secondary means to furnish information about the degree of molecular change at the starch granule surface.

The above tests and analyses have many implications in that they are opposed to the general belief that the chlorine affects the protein by modifying its behavior in the dough. Are the experimental evidences of the "chlorine affects protein" theory contrary to the "protein affects lipid" theory?

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ance) is directly proportional to the absorption, that is, to the water concentration in the flour-water mixture. It appears that the amount of water left in the gluten film of a dough may be controlled primarily by the particular hydration properties of the starch granules. In the capacity of controlling available water within the suspending gluten film of a dough, the starch granules exert influence on dough consistency directly, and probably on dough elasticity indirectly.

The hydrogen-ion concentration in a flour appears to be incidental and, as such, has no influence on hydration properties. Bleaching by Agene ($NCl_3$) or Dyox ($ClO_2$) changes hydration properties; however, the treatment by these gases does not change the pH of the flour.

The alkali number, especially as used by the corn starch researchers, specifically Kerr (13), "may be used to estimate the extent of hydrolysis in a starch product since the value rises progressively as the reaction proceeds." The chemical compounds hydrolyzing starch have to be carried, usually by water, to the starch molecules within the structure of starch granules which are supposed to be hydrolyzed. While this statement is obvious, it also implicitly says that the hydrolyzing chemical compound has to pass through the surface of the starch granule where it passes first the naturally deposited lipids along with some starch molecules. Dependent on the extent and time of the chemical reaction probably sparked by the chemical compound in this region, a certain degree of molecular decomposition or structural decomposition takes place, reducing the resistance of this region against water penetration. Naturally, with increasing water penetration, a larger extent of hydrolysis occurs, as Kerr also stated.

A few simple experiments have been presented and a new approach suggested to explain what flour is and how it may work. Primitive primary observations were used to which many academic and practical types of problems could be attached. This approach may be unconventional, but it is probably useful. If the established routes lead to practical goals and progress is made, the uniformity of established concepts may be praiseworthy. However, if the results are poor or frustrating, the established routes may need to be broadened or even abandoned for routes which lead us to useful results.

The pressure for conformity in our society today often makes it necessary for research workers to choose between their life of comfort and intellectual honesty. The members of the AACC cannot afford the luxury of sacrificing honesty when natural laws, which are independent of personal likes or dislikes, are faced. If nature is to be harnessed, there is no alternative to intellectual honesty.

Attention should be called to some of the loose terminology and even looser concepts widely used in cereal chemistry which keep a number of questions hazy. These questions are a source of steady or recurring embarrassment to research. Here they are:

1. What is the difference between protein matrix and protein?
2. What is the difference between starch granules and starch?
3. Where is the surface of the starch granule?
4. What would be a proper name for the surface where protein matter ceases and starch granule starts?
5. What is the significance, if any, of the different kinds of starch granule surfaces which may be found in a flour?
6. What is starch damage? Is not this an unnecessarily degrading term by its negative connotation?
7. How would optically measurable indices change if all the fats and/or lipids were removed from the granule without altering its molecular architecture except the extraction of lipids?
8. What is the size of the molecular passage by which the water molecules pass through the starch granule surface and/or within the body of the starch granules? How does this change with temperature? What is the energy requirement for the passage of one mol of water through the 100-A region of starch granule?
9. What are the forces which bring hydration about in the starches? In protein? How would it be possible to measure them?
10. What influence has the density of compounds on the rate of water penetration into the starch granules?
11. Are there any nitrogen molecules within the architectural unit of the starch granule? If so, where and how many?
12. Which portion of the Kjeldahl nitrogen value is part of lipoids and which is part of the proteins?
13. How precise is our 5.7 nitrogen factor above 13% and below 6% protein content?
14. What are the protein's coagulation temperatures or temperature ranges? How does it change in the function of moisture content? Is it a function of time?
15. What is the mechanics of gluten coagulation (setting in the oven)? What are the compounds responsible for the phenomenon?
16. What would be the physically or chemically measurable terms of "protein denaturation" which could differentiate significantly in all instances where the term is used?
17. What would be the physically or chemically measurable terms for flour oxidation? Which are the chemical compounds of flour affected by oxidation? What is their strategic location in the endosperm?
18. What is gelatinization? Can it be defined in basic scientific terms? What has it to do with temperature?
19. Why do natural starches rapidly hydrate at gelatinization temperature?
20. What are the melting points of lipids extracted from wheat endosperm?
21. What is the affinity of water to protein? To starch? Can it be measured? If so, how?
22. Why is the viscosity index (farinograph, amylograph, etc.) so stubbornly used to characterize hydration?
23. Are there any other measurable physical means available to characterize primary and secondary hydration capacity? What are they?
24. Why is starch damage measured again and again by different but somewhat glorified maltose methods?
25. Is there a reliable amylase determination method which can be used in the research laboratory or in quality control? If not, why not?
26. Is the absorption figure the only one which is of practical interest in flour hydration? How about the rate of hydration?
27. Is there a point in searching for a relationship between amino acid composition of proteins, gluten, and baking value of the flour?
28. Can't it be realized that the concept of flour based solely on *compositional analysis*, which is only one

technique of the chemical sciences, does not provide the answer for every practical question of art? If so, why aren't other useful concepts used?

Many other questions are possible.


**Summary**

The formulation of practical problems in scientifically measurable terms is one of the toughest challenges the professional men of this society face today, especially in research relations. The very complex problems of what flour is and how to handle it can be efficiently resolved only if basic concepts of flour and its indices are reviewed and new meaningful indices are developed. An unusual approach to explaining flour and its hydration phenomena has been presented based on a few simple experimental approaches.



**Acknowledgment**

The assistance of colleagues with whom I consulted about the subject covered in this article is greatly appreciated.


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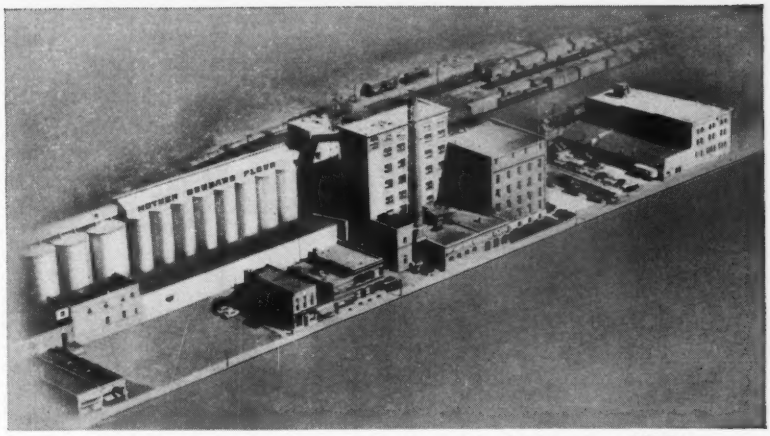

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A RESUME OF RECOMMENDED

# Sampling Techniques for Better Feed Quality Control

By A. B. Poundstone, Department of Feed and Fertilizer, University of Kentucky, Lexington[1]

FUNDAMENTALLY, FEED SAMPLING seeks information about two types of feed products. Let's take as the first type a uniformly mixed product; here, the purpose of sampling is to determine the characteristics of the entire lot.

The second type of product is a heterogeneous, poorly mixed mass of feed. Several cores are taken for sampling the lot, and individual cores are first analyzed to find the characteristics of each part and thus to reveal variation within the mass. Analysis of the combined cores shows the character of the lot as a whole.

A prerequisite to intelligent sampling is some knowledge of the product. Because of experience in sampling blood, a physician knows that one drop will provide information about all of the patient's blood; there is no need to combine drops taken from several places in the body. But tissue taken from one part does not represent all tissue from the same body, whether diseased or free from disease.

One must know something of the characteristics of feeds before sampling procedures are determined. By trial and error, we have built and continue to build this knowledge as a guide in sampling.

Sampling is useful to ingredient suppliers and feed manufacturers in judging ingredients, checking manufacturing methods, and evaluating the quality of finished products. The first requisite, therefore, of a sampling program is an understanding of the product in relation to the purpose for which the information is secured.

### Triers or Samplers

Twenty years ago the investigator on feed sampling for the AOAC, after using three types of equipment, reported that the type of trier was of no significant importance (3). This, apparently, is still true. With a uniformly mixed lot, even though there may be some variation in particle size, it is only necessary that the trier does not classify the particles as they drop into it.

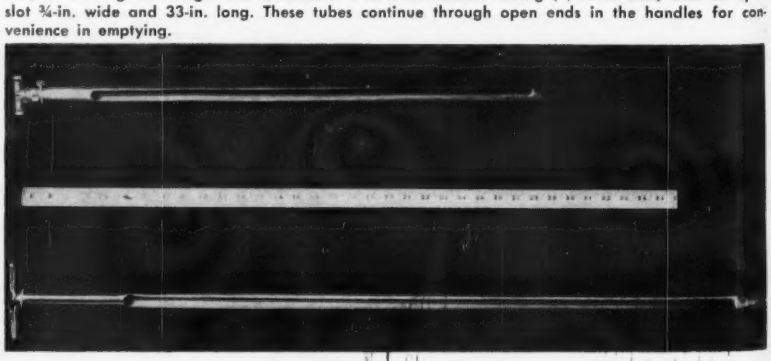
Triers or samplers vary from a cup, through various kinds and sizes of scoops, to elaborately designed, multiple-slotted tubes. S. F. Brockington, chairman of the AACC's committee on feeds in 1954, reported the results of a questionnaire mailed to feed manufacturers. Two-thirds of those who replied were using the standard 10- or 11-slot grain probe, almost 5 ft. long, on bulk shipments. These probes are large in diameter and cumbersome to operate. Most of them have a sleeve arrangement for closing the slots after the sample is obtained. When the sleeve is closed, feeds that tend to be gummy when compressed give a great deal of difficulty.

At the other extreme are samplers less than 12 in. long. At the time of Mr. Brockington's study, the author made a survey with Stacy Randle of New Jersey, the investigator on sampling of fertilizer. One state was using a trier with an effective sampling area less than 6 in. long. In contrast to the grain probe, this would seem to be going too far in the opposite direction.

Only one type of trier will be discussed in detail here—one that combines the essential features (lower one in the photo). It is made of 1/16-in. stainless-steel tubing, 1 in. in diameter. One end tapers 3 in. to a point; the other has a 4-in. T handle. Between is an open slot ¾ in. wide and 33 in. long. Over-all length of the trier is 42½ in.

This trier is satisfactory when sampling is confined to bulk feeds, at rest, in cars and bins. It is a few inches longer than is necessary for sampling bags. A shorter one, such as that shown at top in the photo

Single-slot feed triers. The shorter trier is made of ⅞-in. brass tubing (3/32-in. wall) with a ½-in. slot, 24 in. long. The longer one is made of 1-in. stainless-steel tubing (1/16-in. wall) with an open slot ¾-in. wide and 33-in. long. These tubes continue through open ends in the handles for convenience in emptying.



[1] The author is Associate Referee in Feed Sampling, Association of Official Agricultural Chemists.

(usually not more than 30 in. long) is suggested for bags, to avoid piercing the opposite end of the bag. As bags become smaller, perhaps a still shorter trier will be needed.

Whatever the size and length of trier, a single-slotted tube seems entirely satisfactory. The width of the slot should be in proportion to the over-all size of the tube—not less than ½ in.; where particle size becomes a factor, it should be increased accordingly. An open end, from the trier proper straight through the handle, is especially desirable so that the sample can be transferred easily to a bag or container.

For taking a core, the single-slotted sampler is inserted with the slot down; after it is forced in up to the handle, it is turned so that the slot is up and the material being sampled falls into and fills the sampler. Ideally this should happen without any encouragement such as shaking, twisting, or jiggling.

### Methods of Sampling

With a freight-car load, the first opportunity for sampling is immediately after the door is opened. Here, an objection is frequently raised by those using the long, large-tube grain trier: there is difficulty in forcing the sampler into the feed, because it is piled high and packed tightly. A shorter trier with a smaller tube, like that described here, is more useful and will give just as good a sample. One company follows the plan of clearing the doorway and cutting into the material in each end of the car, leaving two exposed cuts. Three samples are then taken along the wall of each cut and these portions are combined. This method was compared with use of the trier described herein before any of the material was removed, with identical results.

Composition of finished feed may be checked at bagging time by taking a handful from every fifth bag of 40 to 50 and compositing the handfuls. Test runs may also be made, holding the handfuls as separate samples to check variability. (The hand is sometimes called the "pelican sampler.") A further test on variability may be made by probing the bottom, the middle, and the top of a bag with a short probe. Cores secured in this way may be combined or analyzed separately, depending upon the type of question to be answered.

Bulk feeds may be sampled immediately after mixing by holding a small container in the stream, such as a cardboard box with an opening about 6 in. square. A cup may serve quite as well. A plan for sampling feeds containing drugs differs only in intensity from a carefully designed plan for sampling other feeds. These are illustrative of a variety of sampling programs that may be installed to answer special questions. Each calls for a design to suit the purpose intended.

For bagged goods on a warehouse floor, the directions given in the AOAC book of methods (2) probably have not been improved upon: with the bag lying horizontally, a core is taken diagonally from end to end, and the sampler is manipulated as described above.

A type of feed becoming more and more important from the standpoint of sampling is a combination of ground feed and pellets or flakes. So far, no one has proposed a device that is superior to the human hand, thrust into the material as far as possible. Handfuls secured in this way can be combined into a composite or analyzed separately for bag-to-bag variation. Experiments with triers up to a diameter of 1½ in. reveal none to be as reliable as the hand method (5).

### Size of Sample

The official AOAC method calls for 1 lb. or preferably 2 lb. as a minimum. Particle size might play a role here. With a wider spread in particle size, a larger sample is desirable, in which case a larger portion should be ground before it is divided for laboratory examination. In our Kentucky laboratory, we take about a quart and grind a pint.

### Number of Cores in Evaluation of Finished Feeds

Manufacturers and control officials are becoming less and less interested in combining cores from several bags for a composite sample. With today's manufacturing methods and the necessity for thorough mixing of microingredients, uniformity of mix is paramount and a portion of feed taken at any point in a bag or a bulk bin should be a satisfactory sample. To combine portions from several bags only supposes bag-to-bag variability, which is inconsistent with the demands of our time and our manufacturing objective, not to mention advertising claims. If cores are taken from more than one bag they should be analyzed separately, to determine variation between bags rather than the over-all average of the lot. Further, manufacturers should be interested in holding such variations to a minimum, rather than covering them up by compositing cores. Ability to meet guarantees is now used as a basis of judging product reliability, but an additional basis — i.e., a minimum of bag-to-bag variation — will, I believe, be adopted.

Three years ago the number of bags representing an official sample under AOAC methods was reduced. The fact that this method of sampling[2] still calls for cores from several bags indicates a hesitancy to make the change to a core from a single bag, partly because of tradition. Hence it is probably too soon to make such a move. We are, to be sure, moving in this direction.

Sampling methods as outlined by the AOAC are silent on the sampling of such products as liquids, semi-solids, and the types of mixtures represented by flaked and ground feed, or pellets and ground feed. The only reason for this appears to be that the information available is so sketchy that the Association is unwilling to publish what it does have. Those interested can help fill in the gaps.

### Manipulation of Sample

How a sample is handled after it is taken is as important (if not more so) as how it was taken. The larger the variation in particle size, the more carefully the sample must be handled. Experience shows the importance of making certain a sample is thoroughly mixed before a portion is selected for grinding, especially if a riffler is not used. Also, care must be taken after grinding to assure a thorough mix (1).

Dividing a sample after it is taken may present an even larger problem than obtaining it. There is greater possibility of introducing errors in the preparation of a sample than in the process of obtaining it, assuming the use of a trier of sufficient size to admit any of the particles. This is shown by the work of Miles and

[2] The directions are: From lots of 1 to 10 bags, sample all bags; from lots of 11 or more, sample 10 bags. Take one core from each bag sampled, except: for lots of 1 to 4 bags, take enough diagonal cores from each bag to total at least 5 cores.

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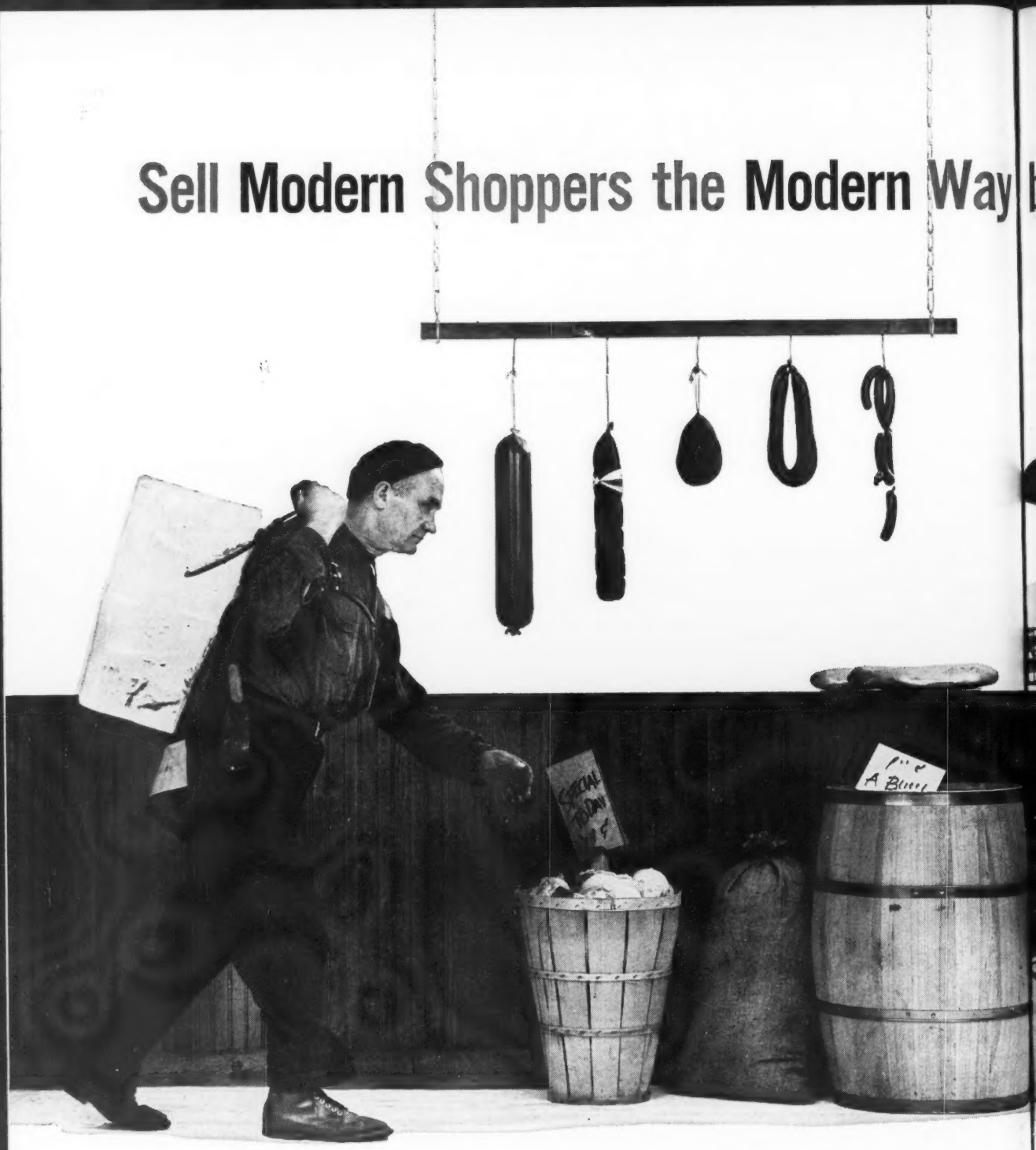


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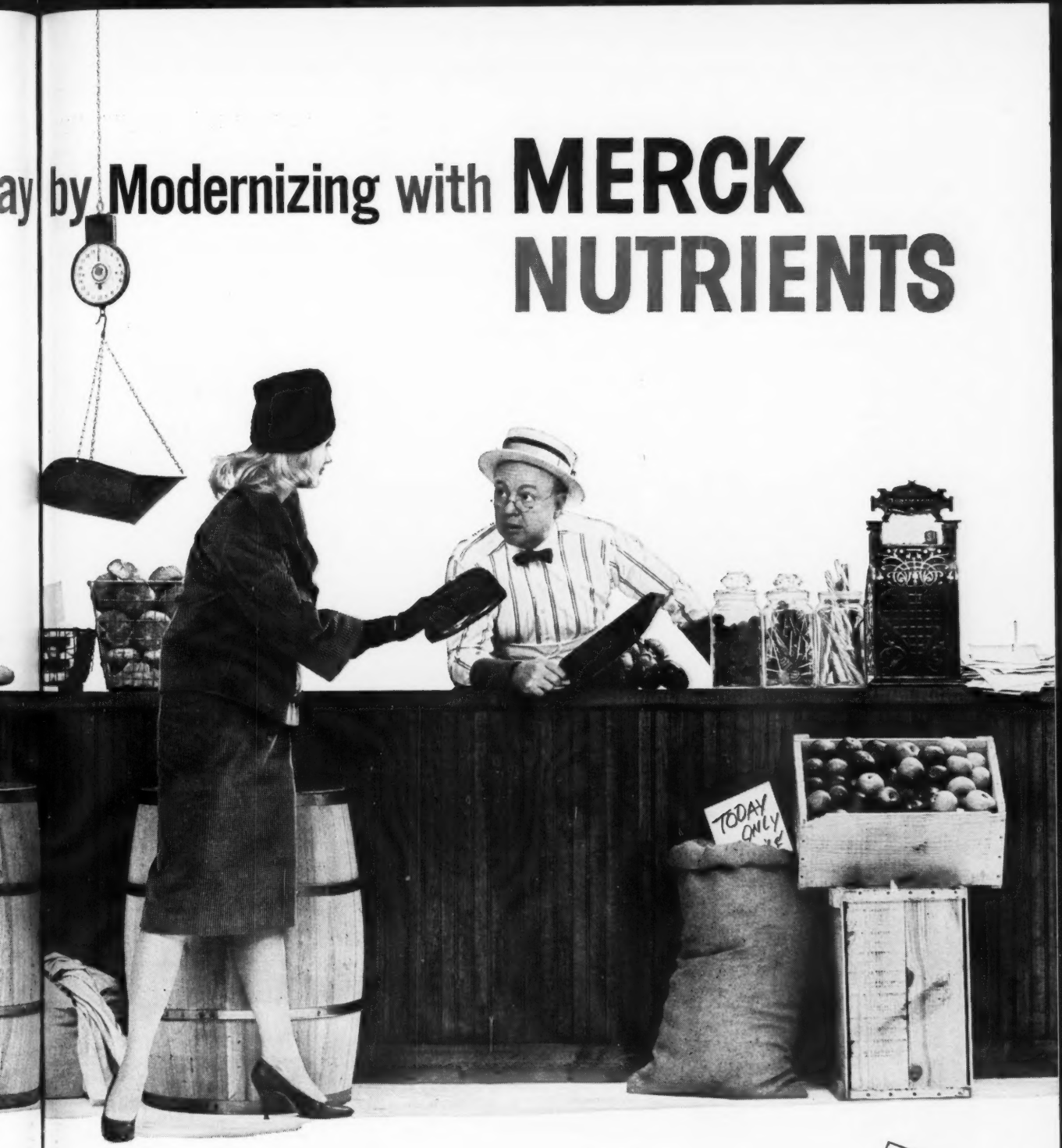


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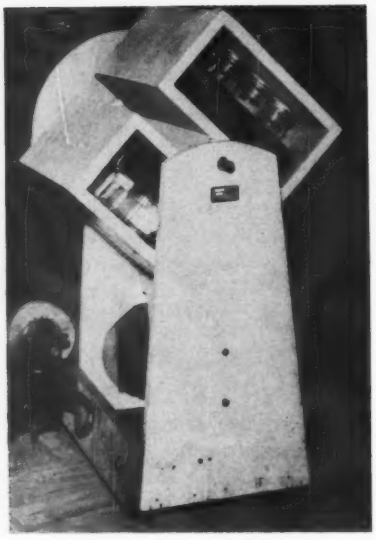
Quackenbush (4), which also indicates that a riffler does a better job of splitting than is ordinarily done by hand-splitting; variations between fractions split by different methods were twice as great from hand-splitting as with a riffler. Interest is always in the direction of holding variation to a minimum. This calls for use of a riffler. The Indiana workers have done a great deal in the past few years to improve rifflers for this purpose (6).

**Grinding and Remixing**

Before chemical analysis, the sample must be ground to pass a 20-mesh screen. Grinding can be a real problem because of variation in texture. In the sample preparation room at the University of Kentucky, three types of mills are used: the Wiley Intermediate, the smallest; a Mikro-Samplmil, which handles most samples; and a standard Wiley mill. Each of these serves a different purpose and on occasion all may be employed in the preparation of a single sample.

The ground material is subjected to thorough mixing, on the Fisher-Kendall or a similar mixer. The sample jars are held on a revolving device that tumbles the sample in a jar (see photo). Dr. Quackenbush and his group in Indiana have a somewhat similar tumbler.



Tumbling device for mixing ground portions of feed samples. Two trays, each holding 12 sample bottles, are tumbled about 100 times at a rate of 25 revolutions per minute.

**Resume**

That we may some day have all of the answers to sampling and the handling of a sample is probably too much to ask. As techniques change and ingredients change, we are continually faced with new problems. For example, good checks on arsanilic acid are difficult to obtain. The Ohio Control Laboratory recently reported evidence that grinding a sample of poultry feed containing arsanilic acid in certain levels lowers the amount that can be recovered. Some variation may need to be allowed also for the type of ingredients and methods of manufacture. The electrostatic quality of ingredients, and hence the necessity of grounding a grinding mill, suggests how variation may be introduced in the sampling and handling of a modern feed.

Nothing is more important than the securing of a sample and its care. Everything that follows depends upon this. Sampling, however, is only as dependable as its intelligent use. A sample will not represent the whole if the whole is heterogeneous. It must be clear whether or not we are trying to determine the qualities of the mass, or variations within the mass. These are two very different things. Trouble arises when cores are combined and then expected to represent the qualities of the mass; actually, the blending of cores only hides variations within the mass.

As Mr. Brockington commented in a letter, it would seem that everybody uses almost any type of sampler he sees fit. This is not to be interpreted as a condemnation of sampling procedures. True, there is no point in deliberately using a sampler smaller than necessary, nor one so large as to become awkward or even useless. The type of sampler is not so important as its intelligent use: principally, to determine the extent of variation within a product by comparing cores. Once a degree of uniformity is established, sampling may proceed as a device to check variation from set standards.

Interest in sampling, therefore, must cover a broad range: what is sampled, why it is being sampled, how cores are to be selected, how combined or handled separately, and how divided; grinding, and finally remixing before presentation for laboratory analysis. The use of intelligence and skill at all points in sampling technique can and does lead to better feed quality control.

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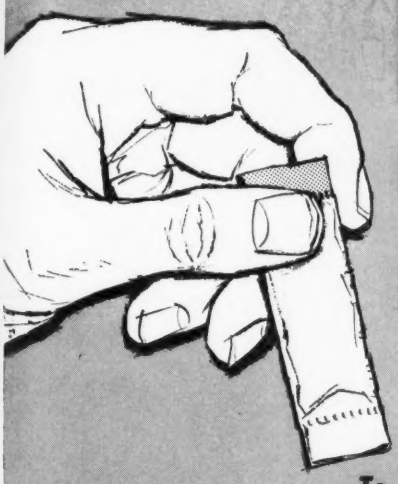

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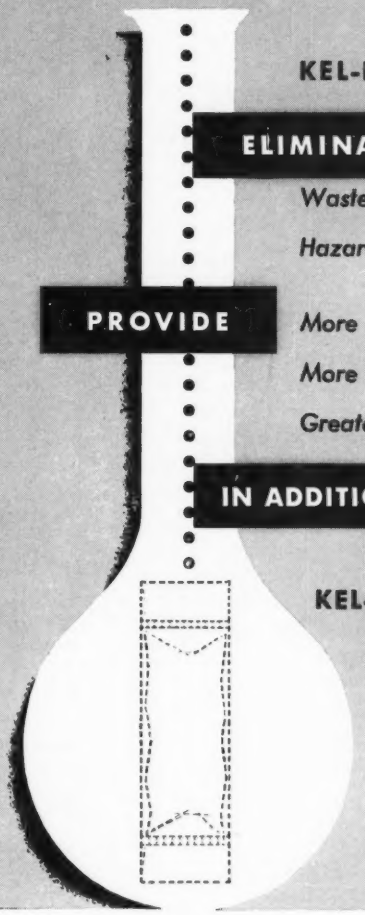

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A STANDARD FOR FOOD COLOR

# How Yellow Is Yellow?

By Lee Campbell, Institute of American Poultry Industries, with Margaret Lally, IAPI Laboratory, and R. H. Forsythe, Iowa State University

A COMMON LANGUAGE DEFINING the color of yolk is important to egg products processors and to users of egg products. Consuming industries need to know how much color can be expected from egg products in order to predict the color of finished products. When one laboratory can report a color related to a universal standard, and compare results, within 10% , of another laboratory, a valuable tool has been created.

A number of tools have been tried before. Once color was measured by eye and judged to be light or dark. Variations of painted paper cards, vials, disks, and actual egg yolks have been used to match visually the color of individual eggs. Fading of painted areas and the difficulty of duplication of patches was responsible for errors in judgment of color.

In 1938, A. W. Turner and V. Conquest devised a laboratory procedure for extracting the color from a weighed sample and matching the extract to a standard aqueous potassium dichromate solution. Nessler tubes were used, and a visual comparison was made against a white background. It was still a visual method.

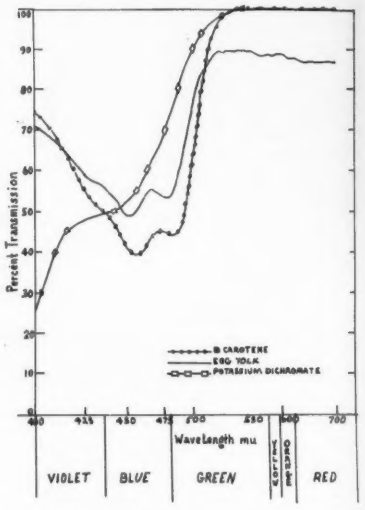
The egg industry and the Research Committee of the then National Egg Products Association asked O. J. Kahlenberg to adapt the Turner-Conquest procedure to an instrument reading. The instrument selected was one that would accommodate the aqueous potassium dichromate standards without dilution of any standards or sample. These standards were then compared with the yolk colors which matched using the Nessler tube method. The same correlation was found, and no great adjustment was needed in number scores, but precision and reliability were much greater than with the visual procedure.

This method became known as the NEPA standard (using NEPA Color Numbers). It proved satisfactory as long as the Cenco-Sheard-Sanford Instrument, with a blue filter, was used to compare the standards to the acetone extracts of yolk samples. When other instruments were used, great variations in color numbers resulted, which caused confusion.

Because egg yolk color is a varying combination of natural substances, an exact standard cannot be made synthetically. The potassium dichromate solutions used by Turner and Conquest and the NEPA method match extracted egg yolk color *visually*, and, by using a rigid photoelectric system, the comparisons of concentration can be repeated precisely. Under a different photoelectric system entirely different comparisons are obtained.

W. O. Pohle and V. C. Mehlenbacher suggested that carotene be used as a standard. This new standard allowed the use of a variety of photoelectric systems for the comparison of natural egg yolk color to the standard. Besides that, synthetic beta-carotene can be obtained in standardized concentration for preparation of the standard solutions.

The Analytical Methods Divisions of the Institute of American Poultry Industries' Research Council and the Institute's Egg Products Laboratory took a close look at this method. The result of their study is called the AOAC method. In this method, the transmission of the standard solutions is plotted on semilog paper in terms of micrograms of beta-carotene per milliliter of solution. The percent transmission of yolk-acetone extracts is compared to this curve. The results are reported per gram of sample.




Spectral transmittance curves using Beckman DK Recording Spectrophotometer.

Fourteen different laboratories participated in the joint tests. These instruments were used: three Cenco-Sheard-Sanford Photolometers, with blue filter of maximum transmission of 410 mμ; and the following, all at 450 mμ: two Beckman DU and two Beckman Spectrophotolometers; three Spectronic "20," two Evelyn; one Coleman Jr. and one Coleman 11.

The results and methods were reported by R. H. Forsythe in the *Journal of the Association of Official Agricultural Chemists*. The method was approved and adopted (as first action) by the Association of Official Agricultural Chemists.

To aid in making the change-over from the NEPA method to the AOAC method, the correlation of NEPA Color Numbers and parts per million

*(Please turn to page 189)*

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IMPORTANT IN FIELD AND LABORATORY USE

# Ultraviolet Light – a Tool for the FDA Inspector

By G. L. Vinz[1] and F. E. Yarnall[2], Kansas City District, U. S. Food and Drug Administration, Kansas City, Missouri

FDA ARMS ITS Inspectors with Black Lights! Truly, by modern news standards, this is a pointed and thrilling-type headline; but actually, Federal Food and Drug inspectors have been equipped with and have been using this essential inspectional tool for some time. Rarely would one of them attempt an inspection of a food or drug-processing plant or even a storage warehouse without it.

In addition to using the black light instrument as a means of detecting rodent evidence in or on stocks of raw materials, finished goods, or packaging containers, FDA inspectors have made extensive use of it when examining food grains for evidence of fungicide-treated kernels which may be present. Its use has also facilitated the examination and segregation of rodent-defiled stocks of foods or drugs, whether on a voluntary basis or by court order.

One of the first field experiences of a new inspector is learning how to operate and use the black-light instrument to find invisible evidence of rodent contamination. True, an ordinary flashlight or extension light will enable him to locate and determine the presence of rodents, but not the urine contamination which is nearly always present. With black light the inspector can follow the paths of characteristic droplets (dried rodent urine), which are highly fluorescent. These droplets appear yellowish white to bluish white under the long-wave ultraviolet lights used today.

Perhaps the best way to understand just how the black-light instrument can be used as an inspectional aid is to follow the step-by-step procedures of an establishment inspection. This will show the sampling techniques used by the inspector when, for example, he encounters a rodent-defiled lot of corn meal.

### Field Techniques: Suspect Areas and Materials

Keeping in mind the knowledge of suspect areas and materials which he has gained through training and experience, the inspector carefully checks basement storage areas, flour rooms, cereal sections, on-the-floor storage practices, receiving and loading docks, "morgue" areas, and the like. He carefully examines raw materials and finished goods found in cloth, burlap, or paper containers; also new or used packaging materials which may be on hand.

### Preliminary Examination

The inspector may use a flashlight or an extension light, whichever is most practical, to determine whether rodents are present. The evidence he looks for may be in the form of excreta pellets, gnawed containers, cut bags, runways, nests, harborages, etc. He may also use the black light to search these suspect areas for the telltale fluorescent spots or droplets.

### Detailed Examination

Having found rodent excreta pellets and several cut bags in a lot of corn meal in cloth bags, the inspector makes notes of these findings and then proceeds to "flash" the exterior surfaces of the bags in the entire lot. He moves the light slowly back and forth over the exposed surfaces of the bags, at a distance dependent on lighting conditions in the area. Should it be fairly well lighted, he may need to hold the light within an inch or two of the bag surfaces; but if the area is dark or can be darkened, he can hold the light 4 to 12 inches away from the bags. The inspector often fashions a "hood" to enhance the effectiveness of the light during his examination.

If he finds several fluorescent streaks on the exposed bags around the perimeter of the lot, the inspector next removes the top layer of bags and proceeds to examine the newly exposed bags. He turns each bag and examines it carefully under the light, following this procedure as he works down the various stacks of bags in the lot.

At the third layer from the top, the inspector may observe numerous fluorescent streaks on the sides of several bags where they overlap. After carefully recording these observations, he sets up his camera and proceeds to photograph the fluorescent areas, which he keeps exposed under the black light. He does not neglect to include other pertinent views such as excreta pellets, cut and gnawed bags, or any other significant evidence of the contamination present.

### Sampling Techniques

Since the inspector has already made a detailed examination of the lot, supplemented by written observations, he next proceeds to obtain physical exhibits of the contaminants and the product for laboratory examination and confirmation. From a representative number of contaminated bags he carefully cuts out a

[1,2] Inspector and Analyst, Kansas City District, U.S. Food & Drug Administration, Department of Health, Education, and Welfare.

portion or section of the fluorescent-stained areas and gnawed or cut areas, along with any excreta pellets which may be adhering to the cloth bags, placing this material in a small envelope and identifying it. He also removes a portion of the corn meal from directly beneath the cut-out sections and puts this material, along with that already in the envelope, into a clean, dry sample jar. Each such exhibit is identified with the particular bag from which it was removed.

After obtaining a sufficient number of exhibits from the lot, the inspector identifies each with a sample number and pertinent information as to bag number or position, layer number, and type and extent of contamination. He affixes an official seal to the sample before submitting it to the laboratory.

### Laboratory Examination and Final Action

Laboratory analysis of the sample confirms the presence of urine on the sacking, and rodent urine and hairs in the corn meal. On the basis of this confirmation by the laboratory, a seizure recommendation is promptly submitted to the Department of Justice, for the removal of this offending material from human food channels.

### Industry's Uses of Black Light

As valuable as black light is to the Food and Drug Inspector in uncovering violations of the law, industry has also found this instrument to be of inestimable value in establishing and maintaining sound sanitary programs. Pecan shellers have found that with black light equipment installed on their sorting belts, employees are better able to detect and remove curculio larvae from pecan meats. Various segments of the grain trade routinely use the light to examine samples of grain for the presence of kernels treated with mercury compounds (wheat originally intended for seed). Flour millers, too, have found black light to be a valuable aid in preliminary examinations of flour samples to determine the adequacy of enrichment additives. The list of uses could go on and on.

As a result of all of this, the consumer, for whose protection and well-being we all strive, benefits as the recipient of a clean, wholesome, and adequate food supply, now and in the future.

### Laboratory Uses: Examining Grain

In the field of cereal work one of the most extensive uses of the ultraviolet lamp, in our laboratories, is in detecting cereal seeds treated with various fungicides, including red dyes which fluoresce under ultraviolet light. The dyes which usually accompany these fungicides show a distinct fluorescence, ranging from pink to brilliant red. Sometimes a fungus growth produces distinct fluorescence of other shades.

Results are best when the work is done in a darkened room and the operator's eyes have become accommodated to the dark. The grain is spread in a thin layer on a tray located a few inches from the ultraviolet source. Slight agitation of the tray rolls the kernels so that those with only localized coloring are more easily seen. Kernels which fluoresce are picked from a weighed sample and weighed. The percent pick-out is calculated. The mercury content of the contaminated kernels is then determined (1). Other chemical sorting methods, not involving ultraviolet light, are used to detect fungicides not accompanied by fluorescence, or those not containing mercury.

### Confirmation of Urine Stains

As in field inspection work, the ultraviolet lamp is used in the laboratory to locate and examine stained areas on containers of food products. Dried urine on textiles or on many papers usually fluoresces with a yellowish to blue-white color, depending upon the material upon which the spots are found. The exact color varies somewhat. Urine stains on cereal kernels themselves seldom fluoresce well. The size, shape, and distribution of the spots should be noted, since this aids in characterizing them as being of rodent origin. If the odor of urine is present, it should be reported as additional evidence of contamination.

The fluorescent stains may be photographed. This is best done in a darkened room, using only ultraviolet light. A filter, such as a yellow K-2 or deeper, must be used on the camera lens to block the reflected ultraviolet and permit the stains to appear as light areas on the finished print.[3] (See photo.) Under certain circumstances such photographs may be made as flash exposures. Details of this method appear in an article by Van Allen (8).

In order to establish contamination of the contents of the stained package, portions of the contents adjacent to the stain should also be subjected to chemical confirmatory tests.

### Specific Laboratory Tests on Suspected Material

After the suspect spots have been located, various tests are used to confirm the presence of urine. This is necessary because many other substances may fluoresce to various degrees. Most such tests depend upon the presence of urea in mammalian urine. A number of such tests are cited in the literature (2,5).

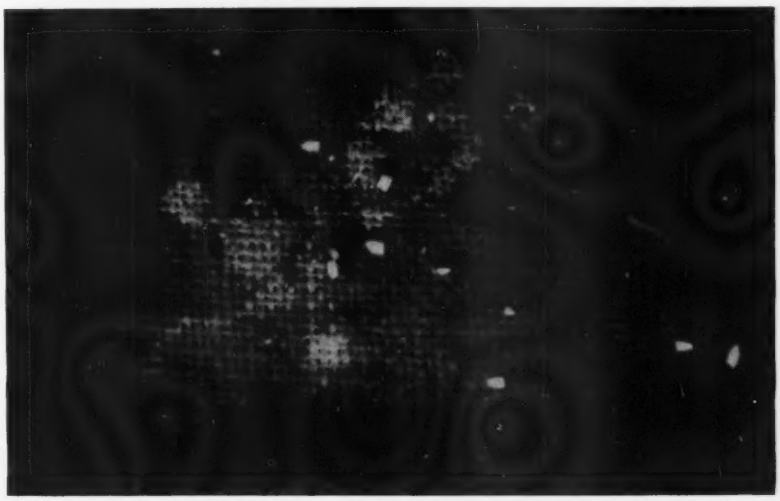
### Other Laboratory Uses of the Ultraviolet Lamp

1. The use of ultraviolet spectro-

*(Please turn to page 189)*

[3] See Eastman Kodak Company's Kodak data booklet, "Infrared and ultraviolet photography," for further information.

Fluorescent stains on burlap bag of beans. (Photo by J. R. Green, U.S.F.D.A.)



# the President's Corner

## news of the association

From all reports coming across my desk, the 45th Annual Meeting of the Association held May 1-5 in Chicago must be classed among the finest. The Local Arrangements Committee, under the fine leadership of Ed Feigon, worked for months to make sure that everything would go smoothly during the week that you were in Chicago. The convention had very few, if any, problems. These problems, when they arose, were taken care of quietly, quickly, and so efficiently that no one knew that the Local Arrangements Committee had any difficulties.

The technical program, which is one of the important reasons why we spend time and money in going to our national meeting, was under the direction of Dr. Robert Koch. I have heard many praises on the quality of the program. It is of interest that Dr. Koch started planning the technical program early in 1959. I mention this to point out that the annual conventions of the Association are not something that fall together in a few hours, but rather, they take weeks and months of planning and diligent preparation. It is a fortunate circumstance that we have members like Bob, Ed, and others who are willing to devote so much time to the success of the national meeting, especially so since the work is entirely extracurricular. It is this spirit of cooperation that makes the Association such an outstanding organization.

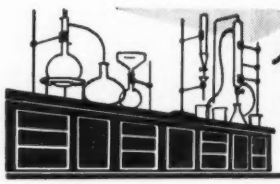
Cecelia and I were indeed sorry that it was not possible for us to be in Chicago during the Annual Meeting to greet personally our many friends. While I was in the hospital, your thoughts and best wishes for a speedy recovery were so very greatly appreciated and helped to make my stay more bearable. I am now back at work enjoying reasonably good health.

Schedules are being made to give me an opportunity to meet most of our members on their home ground. On June 20-21, the Pacific Northwest Section met in Bozeman, Montana, as guests of Montana State College. The local arrangements were magnificently handled by staff members, Clifford Watson and Robert Bequette. It was my privilege to appear on the program to discuss the subject of *Bread Flavor Research*. I do, indeed, look forward to my visits with other local sections during the coming months.

I would appreciate receiving your suggestions on how the national officers can serve the membership more effectively. Perhaps there is some program you would like to see inaugurated; or perhaps, you feel that the Association is working on something which you consider unimportant and you, therefore, wish to see it eliminated; or it may be you have some suggestions to make regarding the material that is appearing in our journals, CEREAL SCIENCE TODAY and CEREAL CHEMISTRY. I urge you to write Dr. Paul Ramstad, Editor of CEREAL SCIENCE TODAY, or to me, expressing your thoughts. It is only through a free exchange of ideas that we can hope to meet the obligations to our membership and to grow in the future.

It is indeed satisfying to be back at work and to have this opportunity of communicating with you. I look forward to visiting with everyone personally in the coming months.

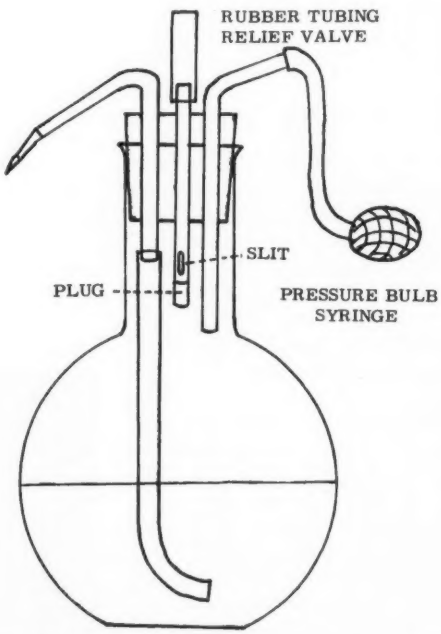
JOHN A. JOHNSON, *President*



## laboratory HELPS and GADGETS

### AUTOMATIC WASH BOTTLE

Kenneth C. Lawson, who is employed in General Mills' flour lab in Buffalo, has devised a wash bottle which he finds useful in handling boiling liquids, acid or alkali. It eliminates applying the mouth to a hot tube, thus avoiding the hazard of burns to lips and tongue. (See illustration.)




By pinching off the relief tube with one finger and developing pressure with the bulb syringe, the operator starts a flow of liquid. This flow can be stopped immediately by opening the relief valve. Once pressure is developed, both hands are available for directing the stream and handling the precipitate. The gadget is particularly helpful in washing residues in fiber analyses.

DONALD C. MEEK

## "RADIOLOGICAL HEALTH DATA"

The first issue of a new monthly technical publication entitled *Radiological Health Data* became available on April 29, 1960. It is an outgrowth of a directive by President Eisenhower, August 1959, that the Department of Health, Education, and Welfare "intensify its radiological health efforts and have primary responsibility within the executive branch for the collection, analysis, and interpretation of data on environmental radiation levels." Within the Department, this responsibility has been delegated to the Division of Radiological Health, Public Health Service. Food-regulatory parts of HEW and the USDA are closely in contact with the task. Editorial advisors include representatives from the departments of HEW, of which the Food and Drug Administration is a part; of Agriculture, of which the Meat Inspection and Poultry Inspection Divisions are parts; the Atomic Energy Commission; and the Defense and Commerce departments.

"Radiological Health Data," Monthly Report, April, 1960, by the U. S. Dept. of Health, Education, and Welfare's Public Health Service, is distributed by the Office of Technical Services, U.S. Dept. of Commerce, Washington 25, D.C., at 50 cents per copy or $3 for a 6-month subscription.

The first issue of RHD contains data on Strontium-90 in milk, as well as radioactivity in fish, air, water, and soil. While the report contains some interpretive discussion, PHS Surgeon General Leroy E. Burney explained that most of the radiation measurements that will be carried by the new publication will be in the form of raw data which are not immediately susceptible to meaningful analysis or interpretation. However, he suggests interpretations will become more feasible later, and it has been mentioned that every third issue may be devoted more to interpretive purposes.

The April 1960 "Quarterly Statement on Fallout" by the AEC is the final issue of that series. Hereafter the new RHD report will contain those data and interpretations. However, for those especially interested in wheat, it should be noted that AEC's April report contains many more data on wheat than does the first issue of RHD. (The May issue of RHD was to carry more of this information on wheat.) Single copies of the AEC report (No. C-78) are said to be available on request without charge while the supply lasts. Several pertinent excerpts from the AEC report are as follows:

Wheat samples collected in 1958 and 1959 continue to show average levels near the maximum levels observed so far, and individual analyses of both wheat and milling products have produced new maximum figures. It is believed that levels of radioactivity in foods depend on both the *rate* of fallout (which is tending to decrease with time) and the total accumulated amount of fallout radioactivity (which is tending to increase with time) although the amount each contributes is not known at this time. The situation as it existed sometime before food sampling is reflected in the radioactivity levels in foods. Levels in foods vary further with agricultural practices, seasons, and types of agricultural products. A study of milling products from 1958 wheat from nine states showed the highest levels of Strontium-90 and calcium in the bran and the lowest in patent flour. Bran levels ranged from 52 to 673 micromicrocuries of Strontium-90 per kilogram with an average of 231, while patent flour ranged from 3 to 42 with an average of 12. Germ, shorts, and clear flour ranged from 50 to 191, 28 to 665, and 6 to 86, respectively.

Samples of 1958 wheat from 15 locations in South Dakota recently analyzed ranged from 44 to 130 micromicrocuries of Strontium-90 per kilogram in winter wheat and 46 to 60 in spring wheat. Some 1959 winter wheat samples from six states, but different states from those for which 1958 wheat values were reported, showed levels ranging from 14 to 198. Levels in 1958 wheat grain from nine states (previously reported in HASL-65 and HASL-69) ranged from 21 to 133 micromicrocuries of Strontium-90 per kilogram of wheat with a weighted average of 62 based on 1958 production. Since values have not yet been received for 1959 wheat from the same states for which 1958 samples have been reported, specific comparison of 1958 and 1959 wheat levels cannot be made at this time. Such comparisons will be possible when collections and analyses of 1959 wheat samples are completed. Levels previously reported for wheat samples from several locations in Minnesota ranged from 17 to 76 in 1956, 47 to 112 in 1957, and 35 to 60 in 1958.

Strontium-90 levels in vegetables from 12 areas in the U.S. collected from May to November 1959 ranged from 2.1 to 48.0 micromicrocuries per kilogram in cabbage, 0.8 to 8.2 in potatoes, 9.2 to 178.2 in soybeans, and 9.1 to 96.4 in wheat. Levels reported by the Food and Drug Administration for 1958 and early 1959 ranged from 2 to 14 in cabbage and 0.5 to 7.3 in potatoes.

Strontium-90 concentrations in samples of New York City whole wheat bread for September, October, November, and December 1959 were 24, 26, 56, and 16 micromicrocuries per kilogram (corresponding concentrations of calcium were 0.90, 0.82, 0.78, and 0.72 grams of calcium per kilogram), and 16, 12, 11, and 8.5 for white bread (0.94, 0.94, 0.88, and 0.59 grams of calcium per kilogram). August values previously reported were 52 for whole wheat bread and 12 for white bread.

With man-made radioactivity superimposed over that of the cosmic background, the maximum permissible or "guide-line" level of radioactivity in water, air, food, and soil has become a regular part of public health surveillance. For example, the National Committee on Radiation Protection and Measurements has recently recommended the maximum permissible radioactivity in water for drinking as follows (micromicrocuries per liter): Strontium-90, 1,000; Strontium-89, 100,000; Cesium-137, 200,000; Barium-140, 300,000; Iodine-131, 20,000; Radium-226, 100.

One might ask, what about other foods, including those made from cereal grains? Secretary Flemming has said recently that under present conditions there is no food regulatory problem, as shown by the food-monitoring activities which are quite substantial with a moderate accumulation of data already at hand.

As in the April 1960 issue of RHD, so too in earlier releases from federal agencies, strontium-90 data on milk have been conspicuous. It could be anticipated that chemically close relatives of calcium, strontium in this case, are of added concern because in the animal or human, strontium likewise is expected to be deposited in the bones. Milk, a fine source of calcium and a possible source of Strontium-90, also a food widely consumed, especially by children, came into the limelight as a radioactivity or monitoring "pilot food."

The guide-line for average daily intake of Strontium-90 is now 33 micromicrocuries per liter or kilogram of total dietary intake, averaged over a period of one year. This is based on best national and international recommendations. With the above guide-line in mind, let's note how several of the basic foods show up under typical dietary circumstances cited by Secretary Flemming:

The following diet shows how the wheat data reported by the

Atomic Energy Commission would be reflected in a typical adult diet. This diet is adapted from one that was presented by the Public Health Service at hearings of the Joint Committee on Atomic Energy last year. An estimated average daily consumption of 1.8 g. of bran, as estimated by the U.S. Department of Agriculture, was added to this diet (rounded in the table to 2.0 g.). The Strontium-90 values for bran and flour products in this diet are the average values of the AEC report. The Strontium-90 values for other items of this diet are considered typical for a large metropolitan area.

**Table I. Comparative Consumption of Strontium-90 in an Average Diet of 2,200 Grams Per Day[a]**

| | *Strontium-90 Content* | *Food Consumption* | *Strontium-90* |
|---|---|---|---|
| | *μμc/g* | *g/day* | *μμc/day* |
| Bran | 0.231 | 2 0 | 0.4 |
| Flour products | 0.012 | 227.0 | 2.7 |
| Foods other than milk, water, and wheat products | 0.004 | 971.0 | 3.9 |
| Milk and milk products | 0.010 | 410.0 | 4.1 |
| Water and other nonmilk fluids | 0.001 | 590.0 | 1.0 |
| Total | | 2,200.0 | 12.1 |

[a] A gram is 1/1000 of a kilogram or 1/28.35 of an ounce.

Now for those particularly interested in wheat and foods made therefrom, here follow another table and statement from Secretary Flemming's news release of April 28, 1960:

**Table II. Wheat Milling Products — 1958 Crop from Nine States (Strontium-90 in micromicrocuries[a] per kilogram) Reported by the Atomic Energy Commission, April 1960**

| *Material* | *Strontium-90* | | |
|---|---|---|---|
| | *Low* | *High* | *Average* |
| | *μμc/kg* | *μμc/kg* | *μμc/kg* |
| Wheat | 21 | 133 | 62 |
| Patent flour | 3 | 42 | 12 |
| 1 and 2 clear flour | 6 | 86 | 28 |
| Germ | 50 | 191 | |
| Shorts | 28 | 665 | |
| Bran | 52 | 675 | 231 |

[a] A curie is a measure of radioactivity equivalent to that produced by 1 g. of radium. A micromicrocurie is one millionth of a millionth of a curie.

The statement of the AEC also shows that up to the present time analyses on the 1959 crop have been completed for whole wheat only. These analyses show results similar to those for the 1958 crop.

Thus it is evident that coordinated and realistic consideration is being given to radioactivity of our environment, including foods. Milk and wheat have had the dubious distinction of being featured as "pilot" foods for monitoring purposes. Milk had a head-start in that respect, with the result that industry protested. The federal agencies increased their publicity on other foods, including wheat.

In the months and years ahead, monitoring will be expanded on staple foods. The data will be reported. Despite the implications, government authorities must release the facts as they know them and let the chips fall where they may. Alert, competent, and conscientious attention is being given to radioactivity in air, food, water, and soil. It is proper that we should continue to learn the facts and be guided accordingly.

FRANK L. GUNDERSON

# AACC LOCAL SECTIONS

**Southern California Section** put on its annual picnic at Newport Dunes Aquatic Park on June 18. Water fun features for the young and not-so-young were swimming and diving, water slides and wading pool, paddle boards, kayaks, sailboats, and boat-launching ramp. Beach fun was provided by trampolines, practice golf course, volley ball courts, and Tahitian train rides. Each family brought its own food, the organization providing liquid refreshments, charcoal, and prizes.

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**Central States Section** met on April 25 at Belvedere Joe Restaurant, St. Louis. Speaker Richard S. Gordon, senior research group leader, Monsanto's Organic Chemicals Division, discussed "Nutritional considerations in supplementation of food and feed."

New officers elected at this meeting were: Thomas Shaughnessy, chairman; Marrien Byer, vice-chairman; and John Watson, secretary-treasurer.

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**Pacific Northwest Section's** 26th annual meeting was held on June 20 and 21 at Montana State College, Bozeman. An excellent program of papers and technical visits was topped off by Montana-style entertainment — a tour of the Gallatin Valley by bus; chicken barbecue at the State College field house; a bowling tournament. The tour and barbecue included both members and the ladies who were guests. The latter also enjoyed coffee hours, luncheons, and a tour of McGill Museum.

Outstanding papers on Monday forenoon were given by A. H. Post of Montana State, on "Departmental organization and research"; John A. Johnson, AACC national president, on "What do we know about bread flavor"; and Frank R. Ofner, president Industrial Processes, Inc., Portland, Oregon, on "Control of cereal starches and sugars."

Tuesday's program, besides the afternoon business meeting, presented reports on activities of two associations — Pacific Northwest Crop Improvement and Montana Grain Growers — and a tour of Montana Cereal Quality Laboratory. Forenoon papers included: "Food additives," J. K. Krum, Sterwin Chemicals; and a series of four by C. A. Watson, R. B. Potts, and R. K. Bequette (the first with Zeke Thies): "Identification of Montana hard red wheats by kernel characteristics"; "Evaluation of the Brabender quadruplex mill"; "Value of the remix straight dough baking procedure"; and "Demonstrating wheat quality to the layman."

Afternoon papers were: "Microtests for flour quality" by H. R. Elling and M. A. Barmore, Western Wheat Quality Laboratory; and "Fate of chlorine in flour bleaching" by W. F. Sollars, Washington State University.

All this was rounded off in fine style by the cocktail hour and annual banquet. Toastmaster was Gene Hayden of the Rust Prevention Association, and banquet speaker was the Rev. Paul B. McLeave, director of admissions and development at Montana State.

# AND NOW...

# The Technical Breakthrough Sought By The Baking Industry For Over 28 Years

**Durkee Discovers the Method For Producing a *Fluid* Emulsifier Shortening**

Since emulsifiers were first introduced to the baking industry over 28 years ago, product development and production men looked to the day when a simple turn of a valve would release a fluid emulsifier shortening.

For if this could be accomplished, it would mark the baking industry's most important development . . . an emulsifier shortening which could be pumped, poured or metered . . . in other words, a prime requirement for fully automated bakery operation.

But the feat remained unaccomplished. In trial after trial, fluid shortenings failed at the introduction of emulsifiers.

Then, several years ago, a Durkee scientist noticed an unusual quality in two disassociated compounds under development . . . an unforeseen compatibility between an experimental non-hydrogenated oil and a unique emulsifier being readied for introduction to the baking industry. When combined under strict environmental conditions, *the resulting product remained fluid!*

Here was the breakthrough, but it proved only the beginning. Durkee's Technical Staff put month after month into refining, adapting and altering formulations. Then, testing; in research lab, pilot plant, baking lab, and testing in accredited outside facilities as required for FDA approval.

Result? A fully approved product with commercial practicability. Even more. Durkee's emulsifier, held in microscopic suspension throughout the fluid, is so functional that it reacts virtually immediately in a batter, holding more oil and water in emulsion than ever before possible. In addition, more air is entrapped in the batter.

To the baker, this means lighter, more tender cakes. It means more cakes per batch, or bigger cakes. It means cakes that retain fresh-baked taste and texture for twice as long as before. It means the end of scooping, scraping or shoveling shortening. It means at long last, a baker can turn a valve and measure an incomparable shortening. And all these mean profit.

Durkee has announced this modern miracle to an appreciative baking industry. It's called Fluid Flex Shortening, and its development is another outstanding product of the research continually in progress in Durkee's Technical Laboratories. Here is where we may be able to help you most whenever your product or process warrants further attention. We'd be glad to help. Just 'phone us or write.

**DURKEE TECHNICAL SERVICE**

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Glidden QUALITY PRODUCTS

# People, Products, Patter

**• • • People**

**Ralph L. Barton** and **Ernest Pence** promoted to section heads in Jell-O research laboratories, General Foods Research Center, Tarrytown, N.Y.; **Richard McCarthy** promoted to project leader in engineering research; **Nino Insalata** also promoted to project leader.

**L. R. Bishop** of London, England, chairman of Analysis Committee, European Brewery Congress, attended the ASBC convention in Minneapolis May 4-12.

**Zenas Block** appointed president of bakery division, DCA Food Industries Inc.; has been with the company for 12 years, serving as vp-research and planning, and will continue as corporate vp. Mr. Block organized DCA's Central Research Laboratories in 1950.

**Robert E. Branch** now with Centennial Mills, Portland, Oregon; replacing **P. A. Larson** who has retired.

**George E. Bredt** elected president, American Society of Brewing Chemists. He is quality control assistant to vp-production, Carling Brewing Co.

**James W. Evans,** vp-research, American Maize-Products Co., elected a member of board of directors; he joined the company in 1950 as director of its research laboratories at Hammond, Indiana. He is AACC's president-elect.

**Robert D. Gaines** and **Frank Kupka** join The Pillsbury Co. as senior chemists in research.

**Majel M. MacMasters** appointed to Flour and Feed Milling Industries staff at Kansas State University, effective July 1; from head of cereal microscopy and quality investigations in the Cereal Crops Laboratory, Northern Utilization Research and Development Division, USDA, Peoria, Ill. Dr. MacMasters is author of many articles in CEREAL CHEMISTRY and other scientific journals; is chairman of the AACC's committee on the revision of Cereal Laboratory Methods, and is active in many other AACC activities. Among her duties at K-State will be conducting research on the problem of wheat conditioning. She will also assist with the teaching program in cereal technology.

**George Garnatz** died suddenly from a heart attack on May 18, while in San Francisco attending the meetings of the Institute of Food Technologists, of which he was president in 1956-57.

Mr. Garnatz, a native of Cincinnati, was director of the Kroger Food Foundation in that city since 1945. He had previously been with the Kroger Co. since 1921, when he established a baking laboratory for them shortly after his graduation from the University of Cincinnati as a chemical engineer.

Mr. Garnatz also was a past president (1939) of the AACC, and was serving as chairman of the Committee on Flour Specifications and Methods for Testing Flour. Besides his long membership in and active participation in committee work for the AACC, his other affiliations, including research fraternities and scientific societies in chemistry, bakery engineering, and food technology, make a long list. He is listed in Chemical Who's Who and American Men of Science.

Patents held by Mr. Garnatz include a device for continuous preparation of cake batter.

He is survived by his wife, Edna, and a daughter, Mrs. Mary Grooms of Cincinnati.

**Samuel A. Matz** of Borden Research Center, **Charles S. McWilliams** of American Institute of Baking, and **Jason Miller** of E. F. Drew & Co. received the Rohland A. Isker Award from Research & Development Associates, Food & Container Institute, for their work in developing an instant bread mix utilizing chemical leaveners.

**Mary Brooke Mahan,** age 66, died in Kansas City April 28, 1960, following an operation. She was in charge of the nutritional laboratory for Doty Laboratories.

Mrs. Mahan was employed in the laboratories of the Purity Baking Company, Sara Lee Bakeries, and Omar, Inc., before opening her own bakery on the Plaza in Kansas City in 1939. In 1949 she retired and spent several years in Texas. She returned to Kansas City and was employed in the Doty Laboratories from 1955 until she died.

Mrs. Mahan was very active in the Association from 1922. She served on several committees and published papers in many cereal publications. Mrs. Mahan was the first woman president of the American Association of Cereal Chemists in 1934-1935. She was a recognized authority in the cake and cookie field.

Mrs. Mahan is survived by her husband, C. B. Mahan, and sister-in-law, Mrs. Bert Minton. All members of the Association will miss her cheery smile and excellent counsel.

**Sven Young** has initiated services as technical consultant in Toronto, Ontario (from position with Canada Packers).

# CLASSIFIED

## SITUATIONS WANTED

**(AACC Members)**

**Married, B.A. with major in chemistry. Two years graduate study. Six years hormone and enzyme experience with large pharmaceutical laboratory. Three years research in flavor, light absorption, packaging studies and development work for national company. At present, technical director for a national chain of bakeries. Reply to: Dept. 10A, CEREAL SCIENCE TODAY, 1955 University Avenue, St. Paul 4, Minnesota.**

• • •

Married, B.S. degree. Twenty-five years experience including domestic and foreign assignments in market planning and development, sales, customer service and quality control. Supervised vitamin testing laboratory. Opportunity for advancement a prerequisite. At present, employed in the pharmaceutical and fine chemical industry. Reply to: Dept. 10B, CEREAL SCIENCE TODAY, 1955 University Avenue, St. Paul 4, Minnesota.

• • •

Married, B.A. with major biology, minor chemistry. Nine years experience as chemist and biologist; experimental milling; general analytical work; sanitation analysis; feed analysis; R & D in air classification of flours; test baking. Desire position in large mid-western city. Advancement opportunities a must. Reply to: Dept. 10C, CEREAL SCIENCE TODAY, 1955 University Avenue, St. Paul 4, Minnesota.

## SITUATIONS OPEN

BIOCHEMIST - ENZYMOLOGIST. Small but rapidly expanding biochemical company offers an unusual opportunity for a well-qualified individual capable of taking complete responsibility for research and product development. Ph.D. with commercial experience preferred but not essential. Now manufacturing base cultures and extracted enzymes for agricultural, baking and other industrial uses. Send complete resume and salary requirements with first letter. All replies treated in strictest confidence. Our employees know of this ad. Reply to: Dept. 6, CEREAL SCIENCE TODAY, 1955 University Avenue, St. Paul 4, Minnesota.

## WANTED TO BUY

Used laboratory equipment for feed or cereal quality control work. Send full description and price. Harris Laboratories, Inc., P.O. Box 437, Lincoln 1, Nebraska.

## FOR SALE

FOR SALE: DESPATCH BAKE OVEN; style 138, 115 volt, 500° Fahrenheit maximum temperature, automatic control; inside dimension 35″ x 20″ x 12″ high. $175 f.o.b. Denver. Also MacMICHAEL VISCOMETER, Fischer; complete, excellent condition; extra cup and plunger for small quantity samples. $250 f.o.b. Denver. Contact: M. A. Rust, Industrial Laboratories Co., 1720 Clay Street, Denver 4, Colo.

## Campbell:

*(Continued from page 180)*

beta-carotene, as obtained on four different Cenco instruments, is given in Table I.

TABLE I.
Beta-Carotene Equivalents per Gram

| NEPA Color No. | Yolks | Whole Eggs | Dried Yolk Solids | Dried Whole Egg Solids |
|---|---|---|---|---|
| 1 | 8–30 | 4–15 | 17–65 | 15–56 |
| 2 | 28–51 | 14–25 | 60–111 | 52–95 |
| 3 | 47–71 | 23–35 | 103–154 | 87–132 |
| 4 | 66–90 | 33–45 | 143–196 | 122–166 |
| 5 | 84–112 | 42–56 | 183–243 | 156–207 |

The advantages of the AOAC method are:

1) The arbitrary standard beta-carotene compares more favorably with the absorption curve of the substances which are responsible for yolk color. (See graph.)
2) Comparable results can be obtained using a variety of spectrophotolometers and colorimetric instruments.
3) Results can be expressed in terms of relative color per gram of product instead of a different relationship for each product — whole egg, liquid yolk, or egg solids.
4) Color of the final product can be easily related to the original color of the egg products used.

In its testing work at its own laboratory, the IAPI is using this color method regularly and has recommended that it be adopted universally. A further recommendation is that specifications for egg products allow a 10% variation between laboratories and instruments.

## Vinz&Yarnall:

*(Continued from page 183)*

photometry is well known.

2. The lamp is also used in the laboratory for detection of compounds by chromatography, either paper or column techniques, where examination of the paper, or column packing material, under ultraviolet light may reveal the location of the compounds under investigation; Mitchell (6) uses this in analyzing chlorinated pesticide compounds.

3. Fluorescent microscopy is becoming more widely used, especially in the medical field. Ultraviolet fluorescent antibody tests were reviewed by Munoz (7). Carter (3) has described the use of fluorescent microscopy in food products. The test uses a specific antiserum to which a fluorescent dye has been attached; the now-fluorescent antibody, by attaching to and making only a specific organism fluoresce, identifies that organism. This technique has been used to identify both living and dead organisms.

4. The ultraviolet lamp is used in detecting Pseudomonas in eggs; decomposition in some types of sea food, such as shrimp; changes in heated oil meals produced by overheating; shell in cocoa; and curculio larvae in pecan meats.[4]

5. Substances of many kinds are separated or detected, since some 3,000 or more substances are known to exhibit some type of fluorescence.

6. End points are detected in chemical titrations; for example, such an end point, with the use of eosin in determining surface-active compounds, is described in *Chemical Abstracts* (4).

7. Otherwise invisible marking materials, applied as dusts, liquids, or crayon marks, are detected. These may be used in coding or otherwise identifying products.

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4. Dolezil, M., and Bulandr, J. *Chem. Abstr. 51:* 6425 (1957).
5. Keppel, G. E. *J. Assoc. Offic. Agr. Chemists 41:* 343 (1958).
6. Mitchell, L. C. *J. Assoc. Offic. Agr. Chemists 41:* 781 (1958).
7. Munoz, J. J. *Anal. Chem. 31:* 983 (1959).
8. Van Allen, J. *Quart. Bull. Assoc. Food & Drug Officials U.S. 22:* 57 (1958).


[4] Ultraviolet Products, Inc., South Pasadena, Calif., issues a number of booklets describing the uses of the light and listing numerous reference sources.

# BOOK reviews

**Problems in the Evaluation of Carcinogenic Hazard from Use of Food Additives.** Food Protection Committee, National Academy of Sciences — National Research Council Pub. No. 749, 1959; v and 44 pp. Price, $1.00. Reviewed by PAUL E. JOHNSON, Food Protection Committee, NAS-NRC, Washington, D.C.

The primary problem in evaluating the carcinogenic hazards from use of food additives is that of recognition of weak carcinogenic properties. Potent carcinogens are readily detected and present little or no problem in this respect. The Committee therefore attempted first to find some general principles upon which to base a practical but adequate procedure for detection of weak carcinogenicity and for using the resulting information in making judgments about use of food additives.

Most of the literature is concerned with strong carcinogens, and the Subcommittee had to base its tentative generalizations upon the information available. The generalizations are: 1) If a substance is carcinogenic for one mammalian species it probably will be carcinogenic for many, but not necessarily all, others. 2) If a substance is carcinogenic by one route of administration it probably will be carcinogenic by others. 3) Under specified experimental conditions there are nontumorigenic levels of exposure to carcinogens.

The report next discusses problems in devising and executing animal tests for carcinogenicity and then lists the procedures suggested by the foregoing review. The suggested procedures are briefly stated: 1) continous feeding of the test substance to rats and mice for their normal life spans and to dogs for at least four years; 2) repeated application to the skin of mice for the normal life span; and 3) single subcutaneous application of the test substance in mice with observation of the animals until their death. Adequate experimental design and observation of results are emphasized, and it is recognized that in particular instances there may be useful additions to or variations in the procedure.

Finally the question of evaluation of hazard is considered. It is necessary to rely upon the results of the animal tests even though they cannot give certain assurance that the results observed in the tests predict what would result from use of the test substance in the general food supply. The stringency of the tests makes it probable, however, that negative findings indicate minimal hazard accompanying use of the material in foods.

Assignment of a tolerance level in foods of a substance shown to be carcinogenic must rest largely on evaluation of alternate risks and values. "Because of the vagueness of present knowledge concerning quantitative aspects of the carcinogenic process, use of any amount of a carcinogen as a food additive probably is justified only if 1) values to the public are such that banning the use would constitute an important loss or hardship, and 2) there is no reasonably good noncarcinogenic alternate."

The Committee does not discuss individual substances that are, or might be, food additives in an attempt to assess hazard from such use, nor does it imply that there is any present hazard. In this report, it is concerned only with developing general principles and procedures that might be useful in making such evaluations. The report was prepared by the Food Protection Committee's Subcommittee on Carcinogenesis: Herbert E. Carter, Chairman; Paul R. Cannon; Charles J. Kensler; Morton L. Levin; James A. Miller; Arthur A. Nelson; and Philippe Shubik.

■ ■ ■ ■

**Lipide Chemistry,** by Donald J. Hanahan with chapters by Frank R. N. Gurd and Irving Zabin. John Wiley and Sons Inc., New York, 1960. Price, $10.00. Reviewed by REID T. MILNER, University of Illinois, Urbana.

This short book (330 pages) emphasizes the biochemistry of lipids. The chapters, following a short introduction, are on isolation and purification, phosphoglycerides, phosphoinositides, sphingolipids, minor phospholipids, simple lipids, association of lipids with proteins and naturally occurring lipoprotein systems. Each chapter has extensive references (11 to 209 per chapter) covering work in the field through 1958, with a few 1959 publications cited. The illustrations and tables are very clearly presented.

The book is excellent. Although written for use in a graduate course, it should be invaluable for anyone beginning research in lipid chemistry and it will be used and appreciated by those who are experienced in this field. Throughout the book the limits of present knowledge and need for further research are pointed out. This summary of recent advances in a difficult area is a tribute to the combined efforts of physical, organic, and biochemists and an inspiration to those entering research in this field.

■ ■ ■ ■

**Biochemical Basis of the Improvement of the Quality of Grain** (Biokhimicheskiye Osnowy Uluchsheniya Kachestwa Zerna), by N. P. Koz'mina (403 pp.). Publishers of Technical and Economic Literature on Questions of Milling and Feed Industries, and Elevator Storage Establishments, Moscow, 1959. Price 15r.50k. Reviewed by W. BUSHUK, Grain Research Laboratory, Winnipeg 2, Canada.

The author of this book, Professor Natalie Kosmin, is known internationally for her many contributions to cereal chemistry in general, and for her work on gluten quality in particular. Her present book can be considered as an up-to-date revision, with

the necessary enlargement, of her earlier *Das Problem der Backfahigkeit.*

The book contains 12 chapters, each dealing with related topics in a series of short sections. Chapter I describes the microscopic physical structure of flour and the processes that occur during formation and fermentation of dough. The next three chapters deal with gluten, proteolytic enzymes, and carbohydrates, respectively, with particular emphasis on the role these components play in determining the baking quality of wheat flour. Amylolytic enzymes are discussed in conjunction with carbohydrates.

Chapter V describes changes in the carbohydrates and proteins of flour during mixing, and chapter VI the processes that occur during baking. Chapter VII deals with flour and bread produced from damaged grain. The types of damage considered are sprouting, frost damage, and damage by insects of the Pentatomidae family. Damage caused by these particular insects leads to an increased solubility or degradation of gluten proteins. Although the mechanism of the damage has not been completely worked out, a number of methods have been used successfully in the Soviet Union to improve the baking quality of flour from damaged grain. These methods include: separation by sieving of heavily damaged kernels which are generally smaller than normal kernels; separation of most of the damaged flour during milling, made possible by the fact that this flour is produced during the first break; treatment of the flour either with heat (75° to 90°C.) at high moistures, or with infrared radiations; and addition of lactic acid or potassium bromate to the liquids used to mix the dough.

Chapter VIII discusses the basic properties of wheat flour which give it the peculiar dough-forming characteristics. In addition, this chapter has sections on test baking as a method for evaluating flour quality, on protein quantity and quality as factors in baking quality, on the interaction of starch and proteins (synthetic doughs), and on indirect methods for assessing quality of flour. Chapter IX deals with improvement of baking quality by additions of various enzyme preparations and of chemicals such as potassium bromate and potassium iodate, and by hot conditioning.

Chapters X and XI are concerned with changes in the biochemical properties of grain and flour caused by ionizing radiations and changes in the quality of flour during prolonged storage periods. The last chapter discusses some of the more important general methods of improving the quality of grain, flour, and bread. These include selection of good wheat varieties for seed, and careful control of various operations in agricultural, milling, and baking technology.

Professor Kosmin has provided an excellent survey of the biochemistry of flour from the point of view of baking quality. To do this, she has drawn freely from the scientific literature of all countries engaged in cereal research; each chapter has a list of references, including papers published up to 1957. It is of interest to note that each reference is given in its original language. The author's comments are well substantiated by figures and tables of data from international journals. A few minor typographical errors do not detract from the value of the book. It should be a good reference for cereal chemists in both control and research laboratories.

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**The Merck Index of Chemicals and Drugs,** 7th ed. Published and distributed by Merck & Co., Inc. Price, $12.00. Order from Publications Dept., Merck & Co., Inc., Rahway, N.J., or from local bookdealers.

The Seventh Edition of the Merck Index contains about 1,600 pages of text covering nearly 10,000 descriptions of individual substances and more than 3,300 structural formulas.

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■ ■ ■ ■

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**Radiological Health Data,** monthly report prepared by Public Health Service, U.S. Department of Health, Education, and Welfare. Order (PB 161371) from OTS, U.S. Dept. of Commerce, Washington 25, D.C.; 50 cents a single issue or $3 for an initial 6-month subscription.

The first issue of this report is dated April 1960; every third issue will be expanded into a quarterly report. Contains statistical information on current radiation levels in environmental media such as air, water, milk, and other foods, as submitted to Public Health Service by Federal Agencies, state and local agencies, and other research groups. Other radiation data related to the medical and industrial uses of radioisotopes and X-rays will be included as such data are developed and reported. Production of the report is one phase of HEW's compliance with an August 1959 directive of the President to intensify radiological health efforts. (See "Washington Highlights," page 185, for a fuller discussion.)

**Current Review of the Soviet Technical Press.** Sold on subscription (order No. 60-21441) by OTS at $7 for 6 months ($2 additional for foreign mailing).

A weekly review of scientific and technical articles appearing in the Soviet press, and of significant new Russian books. The time lapse between appearance of an original article in a Russian publication and its review in *Current Review* is no more than a few weeks and usually within a month, according to OTS. The reviews cover articles in many fields of science and technology. Articles are not translated in their entirety, but each review gives a citation to the original Russian publication, including page numbers. The reviews are prepared by an agency of the U. S. Government.

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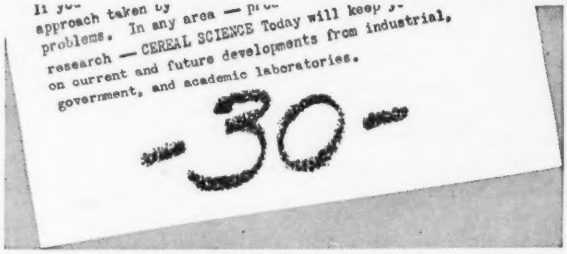
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